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Profile of Resource Adequacy in the MISO Region

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Acronyms and Abbreviations

BPA	Bonneville Power Administration
CAISO	California Independent System Operator
CEL	Capacity export limit
CIL	Capacity import limit
CO_2	Carbon dioxide
CSAPR	Cross-State Air Pollution Rule
CVaR	Conditional value at-risk
D.C.	District of Columbia
DOE	Department of Energy
Entergy	Entergy Operating Companies
EPA	Environmental Protection Agency
EPP	Electricity Procurement Plan
ERCOT	Electric Reliability Council of Texas
ESPA	Energy Sector Planning and Analysis
FERC	Federal Energy Regulatory Commission
FFE	Firm flow entitlement
GW	Gigawatt
ICAP	Installed capacity
IRP	Integrated Resource Plans
ISO-NE	Independent System Operator New England
IUB	Iowa Utilities Board
JCM	Joint and Common Market Initiative
JOA	Joint Operating Agreement
LOLE	Loss of load equivalent
LOLH	Loss of Load Hours
LRZ	Local Resource Zone
LSE	Load Serving Entity
LTRA	Long-Term Reliability Assessment
MAPP	Midcontinent Area Power Pool
MATS	Mercury and Air Toxics Standards
MISO	Midcontinent Independent System Operator, Inc.
MRO	Midwestern Reliability Organization
MTEP	MISO Transmission Expansion Plan
MW	Megawatt
NERC	North American Electric Reliability Corporation
NETL	National Energy Technology Laboratory
NS	Not Studied
NYISO	New York Independent System Operator
OATT	Open Access Transmission Tariff
OMS	Organization of MISO States
PAR	Phase Angle Regulator
PJM	PJM Interconnection, LLC
PRM	Planning reserve margin
PSC	Public Service Commission
PSCW	Public Service Commission of Wisconsin
RAA	Reliability Assurance Agreement
RFC	ReliabilityFirst Corporation
RTO	Regional Transmission Organization
SAWG	Supply Adequacy Working Group
SEA	Strategic Energy Assessment
SERC	SERC Reliability Corporation
SPP	Southwest Power Pool, Inc.
SSR	System Support Resource
TBD	To be decided
UCAP	Unforced capacity
U.S.	United States
WECC	Western Electricity Coordinating Council
WI-UPMI	Wisconsin – Upper Peninsula (Michigan)

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Executive Summary

The Midcontinent Independent System Operator, Inc. (MISO) is facing a number of challenges to their resource adequacy. Factors such as the Mercury and Air Toxics Standards (MATS) related retirements, lack of sufficient new generation coming on-line, transmission constraints, market forces and regulatory uncertainty are just a few of the issues. Regardless of what may transpire in the mid-to long-term for MISO, the current short term (2014-2016) focus identifies potential issues associated with generation retirements and retrofits and transmission system issues.

Large amounts of coal-fired generation (~11 GW) are expected to retire in the MISO region by 2016. These units have been rendered uneconomic due to the declining price of natural gas, expensive retrofits necessary to maintain compliance with new environmental regulations, and advanced age. MISO is also projecting nearly 2 GW of other retirements, mostly older, uneconomic gas-fired plants. However, new generation is not expected to come online in amounts sufficient to offset these retirements. These circumstances are a cause for concern over MISO's ability to maintain sufficient capacity to meet demand in the next few years.

Adding to this concern, generators in the MISO region have been slow to announce retirements. Even several months prior to the United States (U.S.) Environmental Protection Agency's (EPA) April 2015 deadline for Mercury and Air Toxics Standards (MATS) compliance, 0.9 GW of coal-fired generation in the MISO North and Central regions remained uncommitted to either retrofitting or retiring.[1]

Additionally, only 13 percent of the 39.5 GW of generation in MISO North and Central that is committed to retrofitting has completed the necessary upgrades.[2] In order for units to complete these retrofits in time to meet the deadline, MISO has had to extend its outage schedule to include winter months, an action that could reduce the transmission system's reliability. MISO normally schedules outages only during the spring and fall months, when demand is lowest and the system has sufficient excess capacity to absorb the demand. The lessons of the extreme weather experienced during the winter of 2013-2014 indicate that a severe weather event coupled with higher-than-normal outages can stress even those regions that have sufficient capacity to meet North American Electric Reliability's (NERC) reference margins.

A robust transmission system could allow MISO to import sufficient capacity to meet its projected shortfall in generating capacity. However, instead of importing from neighboring systems, capacity located within MISO is being committed to export power to serve the PJM Interconnection, LLC's (PJM) capacity market.[3] Additionally, MISO appears to be addressing problems involving transmission-constrained areas by increasingly relying on System Support Resource (SSR) agreements, which can prevent generation plants from retiring. Further, the analysis in this report shows that MISO North and Central will have a self-sufficiency shortfall

[1] Due to the time that is necessary to complete these retrofits prior to the April 2015 deadline (or for waivers received), it may be assumed that these remaining plants will, in fact, retire; however, as of the 1st Quarter 2015 survey (April 2015), they have not yet provided notification to MISO. Quarterly Surveys may be found at: https://www.misoenergy.org/WHATWEDO/EPAREGULATIONS/Pages/EPAStudies.aspx .

[2] Of the remaining 28 GW of generation that require retrofits, 22 GW of generation have either been granted waivers, or have pending waiver requests.

[3] **Midcontinent Independent System Operator, Inc. (MISO).** 2013 Transmission Expansion Plan. Carmel : MISO, 2013.

by 2016, with anticipated certain capacity.[4] This is in part due to transmission constraints leaving capacity stranded within zones.

Further complicating the generation resource challenges it is facing, MISO is limited in its ability to increase the amount of generation in its system to enforce obligations to meet load. MISO has the ability to, and does, set reserve planning margins; however, it is ultimately up to the states to set their own resource planning margins for Load Serving Entities (LSEs). Similarly, while MISO sets resource adequacy requirements, each LSE is responsible for meeting that requirement, and enforcement of an LSE's obligation to meet load generally lies with the state. All MISO states have adopted the margins set by MISO.

Finally, MISO may be facing new environmental regulation with the potential to cause even more generator retirements, as the EPA is considering new limits on the greenhouse gas emissions from existing power plants. In order to assess the impact of the proposed emission guidelines for greenhouse gases, EPA modeled potential generator retirements. EPA noted in its discussion of retirements that the model it used assumed that NERC reference margins would be met; in other words, the model assumes that sufficient existing generation and/or new generation will be available.[5] This does not appear to be a reasonable assumption for MISO based upon the serious potential generation shortfall in the near-term under existing circumstances; an additional 26 percent reduction, which is EPA's estimate of the additional impact of greenhouse gas regulations,[5] would be 15 GW of generator retirements over the long term. This is likely to exacerbate the problems with near-term shortfalls and reliability issues, potentially leaving MISO with negative reserve margins in the near future.

Overall, this report identifies potential issues with generator retirements and retrofits, as well as potential transmission issues in the system, including the impact of imports and exports as it profiles the short-term outlook for resource adequacy in the MISO region. The report and analysis are specifically concerned with the generation capacity expected to be available in the MISO North and Central regions from 2014 to 2016. As detailed in this report, both MISO and NERC are projecting that MISO North and Central will experience generation shortfalls by 2016. The report describes some of MISO's efforts to better quantify the potential shortfall it is facing in 2016, as well as additional concerns regarding transmission and proposed environmental regulations.

[4] Certain capacity includes generating units that are operating, permitted, and under construction.

[5] **Environmental Protection Agency (EPA).** *Regulatory Impact Analysis for the Proposed Carbon Pollution Guidelines for Existing Power Plants and Emission Standards for Modified and Reconstructed Power Plants.* Washington, D.C. : EPA, 2014.

1 Introduction

In the past year, the Regional Transmission Organization (RTO) Midcontinent Independent System Operator, Inc. (MISO) has been projecting a potential generation shortfall by 2016.[6] Within MISO, large amounts of coal-fired generation are expected to retire by 2016. These units are rendered uneconomic due to the declining price of natural gas, expensive retrofits necessary to maintain compliance with new environmental regulations, and age. In addition, new generation is not expected to come online in amounts sufficient to offset these retirements.

In a December 2013 presentation to the MISO Supply Adequacy Working Group (SAWG), MISO presented the results of the *Resource Assessment Survey of all Load Serving Entities (LSE)* within the MISO region. The results predicted that by 2016, anticipated reserve margins would fall to 7 percent in the MISO North and Central regions, down from 18 percent in 2014, with a shortfall of 8.5 GW.[7] The North American Electric Reliability Corporation's (NERC) 2013 Long-Term Reliability Assessment (LTRA) was consistent with the results of that survey, projecting that MISO's anticipated reserve margin should fall to 7 percent in 2016.[8] However, in February 2014, MISO announced that updates to the survey results reduced the projected shortfall. MISO now projects a shortfall of 2 GW for 2016, down 6.5 GW from its original estimate. More than half of the discrepancy between these two estimates (3.5 GW) comes from generation that was previously counted as retiring, and is now expected to remain in operation.[9] The updated survey results also include additional merchant generation that is "unclaimed," or not currently contracted to serve load. This revision is reflected in NERC's 2014 LTRA, which projects that MISO's anticipated reserve margin will fall to 12.9 percent in 2016.[10] Although higher than the reserve margin projected in the 2013 LTRA, 12.9 percent is still below NERC's 14.8 percent planning reserve margin. This calls into question the amount of generation that can be assumed to be retiring, and how great a generation shortfall MISO may be facing in the near future. Analysis of this question is included Section 4.

This report profiles the MISO North and Central regions to further analyze these issues, focusing on the 2014-2016 period. Only the North and Central regions are included, because the MISO South region is expected to have excess generating capacity during this period, and is tariff constrained from exporting more than 1,000 MW of power to the rest of MISO.

The MISO North and Central regions constitute the "original" MISO footprint, before the integration of the Entergy Operating Companies (Entergy) and several others into MISO on December 13, 2013. Exhibit 1-1 shows the MISO North and Central regions in blue and green, respectively; MISO South is shown in orange. As seen in the map, MISO South is only narrowly

[6] **Wieldon, Esther.** MISO forsees 2-GW shortage in 2016, says operations will be tight. *SNL News.* [Online] February 5, 2014. [Cited: June 30, 2014] http://www.snl.com/interactivex/article.aspx?id=26772745&KPLT=6.

[7] **Midcontinent Independent System Operator, Inc. (MISO).** MISO-OMS Survey Results SAWG. [Online] December 2013. [Cited: June 18, 2014] https://www.misoenergy.org/Library/Repository/Meeting%20Material/Stakeholder/SAWG/2013/20131205/20131205%20SAWG%20Item%2003%20OMS%20MISO%20Survey%20Results.pdf .

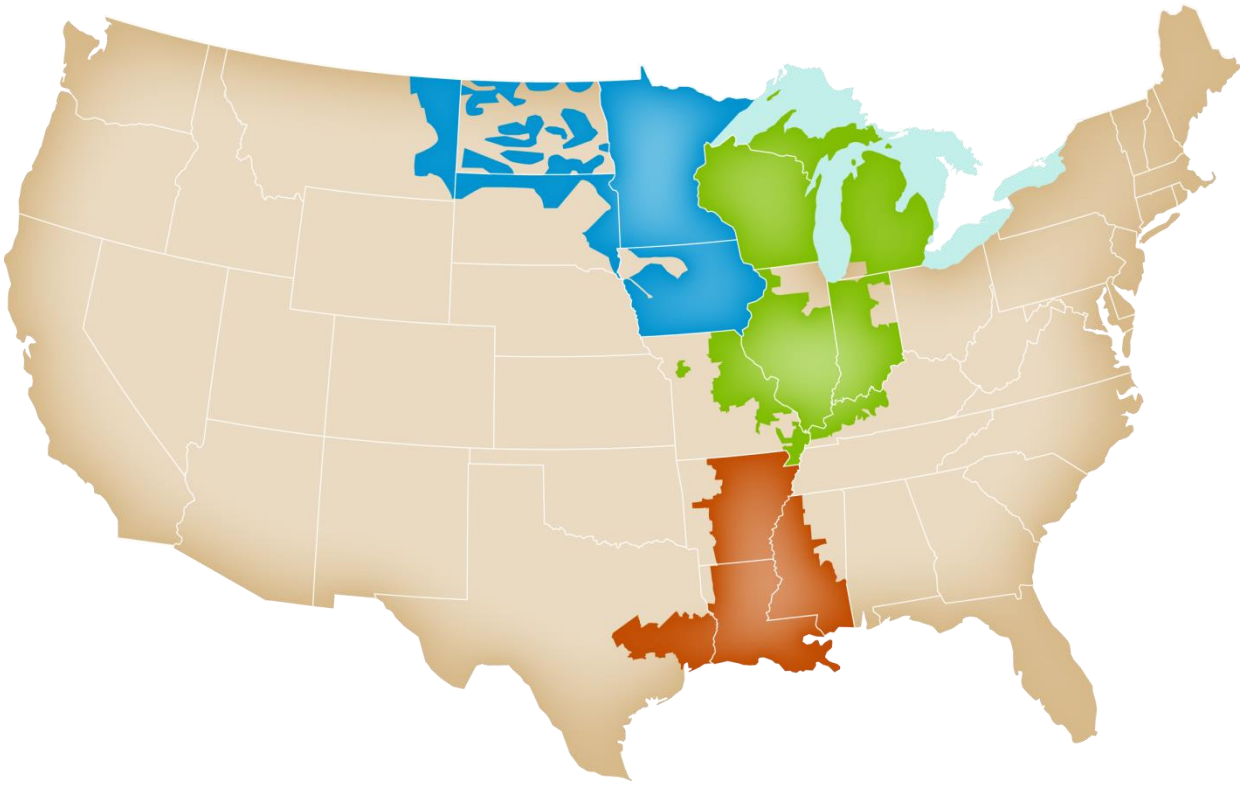
[8] **North American Electric Reliability Corporation (NERC)**. 2013 Long-Term Reliability Assessment. Atlanta. 2013.

[9] **Midcontinent Independent System Operator, Inc. (MISO).** OMS/MISO Resource Adequacy Survey Update. [Online] February 2014. [Cited: June 18, 2014] https://www.misoenergy.org/Library/Repository/Meeting%20Material/Stakeholder/SAWG/2014/20140206/20140206%20SAWG%20Item%2004%20OMS-MISO%20Survey%20Update.pdf.

[10] **North American Electric Reliability Corporation (NERC)**. 2014 Long-Term Reliability Assessment. Atlanta. 2014.

connected to the rest of MISO; currently there are no physical ties and only one contract tie connecting the South and Central regions. Flows between the regions are limited to a 1,000 MW contract path. Any power flows beyond that would utilize transmission capacity owned by members of Southwest Power Pool, Inc. (SPP). Although MISO argues that it has the right to access unreserved transmission capacity on SPP's system, SPP has objected, arguing that MISO must build its own capacity or pay for the use of SPP's capacity.[11] MISO has agreed to limit transfers on the 1,000 MW contract path since April 2014, when the Federal Energy Regulatory Commission (FERC) issued a ruling that ordered MISO to pay for any flows over SPP's system while FERC adjudicates the matter.[12] Thus, until FERC rules further, or the parties reach a settlement agreement, no more than 1,000 MW of generation within MISO South is available for use in MISO North and Central.

Exhibit 1-1 Map of MISO region in the United States



Used with permission from MISO

This report attempts to identify any potential issues with generator retirements and retrofits, as well as potential transmission issues in the system, including the impact of imports and exports on MISO. Section 2 reviews current assessments of retirements and resource adequacy in MISO.

[11] **Federal Energy Regulatory Commission (FERC)**. Order on Remand and Complaints, Accepting and Suspending Service Agreement, Consolidating Proceedings and Establishing Hearing and Settlement Judge Procedures. Docket No. ER14-1174-000. [Online] March 28, 2014. [Cited: November 2, 2014] http://www.ferc.gov/CalendarFiles/20140328180137-ER14-1174-000.pdf

[12] **Wolff, Eric.** MISO limits flows to south after FERC orders it to pay for transmission use. *SNL News.* [Online] April 9, 2014. [Cited: June 30, 2014] http://www.snl.com/interactivex/article.aspx?id=27708803&KPLT=6.

Section 3 identifies areas of potentially stranded generation or other transmission-related issues that may be worsened by generator retirements. Section 4 provides a discussion on the MISO resource adequacy/reliability requirements, including utility obligation to serve loads. Section 5 addresses any additional potential impacts on the MISO North and Central regions from the reinstatement of the Environmental Protection Agency's (EPA) Cross-State Air Pollution Rule (CSAPR)[13] and the announcement of EPA's proposed greenhouse gas regulations.[14] Section 6 provides a summary and conclusion.

2 Retirements and Retrofits of Existing Generation

NERC's 2013 LTRA expressed concern for MISO's ability to maintain resource adequacy past 2015.[15] The assessment predicted that MISO's anticipated summer reserve margin for 2016 will fall to 7.0 percent, which is 7.2 percentage points lower than the required 14.2 percent reserve margin for MISO, and existing generation resources in MISO will be reduced by 10,382 MW from 2013 to 2016, due to retirements and suspended operations. The 2013 LTRA noted that there is potential for MISO to make up some of its projected shortfall by adding generation, increasing demand side management resources, importing from MISO South, and constructing transmission upgrades. It also noted that these projections are uncertain, and MISO is continuing to gather data in order to develop more precise estimates.[16]

NERC's 2014 LTRA revises the estimates upward for MISO's 2016 shortfall, projecting that MISO's anticipated summer reserve margin for 2016 will be 12.9 percent.[10] The 2014 LTRA notes that the new estimates are based partly on the data gathering that was performed by MISO in 2014, which is discussed in detail below. Although MISO South is included in the 2014 LTRA, it has limited effect on the estimated reserves in MISO. MISO South's excess reserves are treated as transmission-limited resources and constrained to the 1,000 MW contract path that is allowed between MISO South and the rest of MISO. Thus, they are not counted toward MISO's available reserves beyond the 1,000 MW contract path.

In coordination with the Organization of MISO States (OMS), MISO undertook a survey (Resource Assessment Survey) of LSEs in order to forecast resource adequacy. This survey requested information from LSEs on their expected load growth, existing and future demand side management programs, and future resource assumptions. The most recent results of the Resource Assessment Survey, presented to the SAWG in June 2014, projected a 2.3 GW reserve margin shortfall in MISO North and Central.[17] Similarly, earlier survey results reported in February 2014 show a projected shortfall of 2.3 GW.[9] This shortfall is much lower than the 8.5 GW shortfall originally reported when the survey results were shared in December 2013.[7] The 8.5 GW shortfall would result in MISO's reserve margin falling to 7 percent, which is consistent

[13] **Environmental Protection Agency (EPA).** Cross-State Air Pollution Rule (CSAPR). Federal Implementation Plans: Interstate Transport of Fine Particulate Matter and Ozone and Correction of SIP Approvals, *Federal Register* August 8, 2011.

[14] **Environmental Protection Agency (EPA).** Standards of Performance for Greenhouse Gas Emissions from Existing Sources: Electric Utility Generating Units. *Federal Register* June 18, 2014

[15] The 2013 LTRA did not include the MISO South region as part of MISO, since MISO did not assume reporting responsibility for MISO South until 2014.

[16] **North American Electric Reliability Corporation (NERC).** 2013 Long-Term Reliability Assessment. Atlanta. 2013.

[17] **Midcontinent Independent System Operator, Inc. (MISO).** 2016 Resource Adequacy Forecast. [Online] June 5, 2014. [Cited: July 7, 2014] https://www.misoenergy.org/Library/Repository/Meeting%20Material/Stakeholder/SAWG/2014/20140605/20140605%20SAWG%20Item%2003%202014%20OMS-MISO%20Survey%20Update.pdf.

with the results of NERC's 2013 LTRA. MISO explained that the changes from December to February were the result of a decreased demand forecast combined with the inclusion of resources that were previously uncounted, unclaimed (merchant generation available but not contracted to serve load), or reclassified from retirement/low confidence.[9]

The uncertainty surrounding these projections, even for the near-term, becomes apparent when they are explored in detail. For instance:

- Although the updates from February and June 2014 vary by only 0.3 GW, the June update projected a 4 GW increase in load and a 3.7 GW increase in capacity resources over January. MISO stated in the June update that although it is currently projecting very little new generation, it fully expects its projections to change significantly as future capacity plans become more certain.[17]
- MISO included all unclaimed merchant generation in the Resource Assessment Survey results, which as of the June 2014 update, is 6.6 GW. These resources have not been contracted by any of the LSEs within MISO, and could potentially be unavailable to MISO. Capacity Suppliers (Exelon Corporation, Dynegy Inc., and NextEra Energy Resources, LLC) filed a motion[18] concerning FERC's acceptance of MISO's 2012 Order on Resource Adequacy Proposal.[19] This motion states that FERC's acceptance implies that the current capacity market is insufficient to ensure reliability over the long term and that single markets are most likely to result in the most efficient amount and mix of capacity. The motion also argues that current market revenues are insufficient to incentivize new generation development. MISO's answer to the motion states that the supplier filing exaggerates how likely a shortfall is in the potential future reserve margin by placing too much emphasis on the uncertainty around demand and response forecasts by LSEs, as well as relying too greatly on the potential shortfalls forecasted by the LSEs. MISO states that the Integrated Resource Plans (IRP) will continue to be developed in the years leading up to the 2016 projections.[20, 21]
- MISO has excluded all generation within MISO that has cleared the PJM Interconnection, LLC (PJM) capacity market, and is thus committed to selling its generation into the PJM market. It is notable that the 2013 MISO Transmission Expansion Plan (MTEP) report states that 2.7 GW of generation within MISO is currently sold into PJM – enough to make up the shortfall projected by the Resource Adequacy Survey if it were committed to MISO instead.[22] This is expected to increase to 4.1 GW

[18] **Capacity Suppliers**. Motion for Expedited Action. FERC. Docket No. ER11-4081-001. August 25, 2014.

[19] **Federal Energy Regulatory Commission (FERC)**. Order on Resource Adequacy Proposal. Docket No. ER11-4081-000. [Online] June 11, 2012. [Cited: October 2, 2014] http://www.ferc.gov/EventCalendar/Files/20120611113217-ER11-4081-000.pdf.

[20] **Midcontinent Independent System Operator, Inc. (MISO)**. Answer to Indicated Capacity Suppliers' Motion for Expedited Action by Midcontinent Independent System Operator, Inc. FERC. Docket No. ER11-4081-001. [Online] September 9, 2014. [Cited: October 2, 2014] https://www.misoenergy.org/Library/Repository/Tariff/FERC%20Filings/2014-09-09_Docket%20No.%20ER11-4081%20MISO%20Answer.pdf.

[21] Each utility must explain how it plans to use existing and future resources to meet customer demand in its IRP, which must be approved by state regulators prior to implementation.

[22] **Midcontinent Independent System Operator, Inc. (MISO).** 2013 Transmission Expansion Plan. Carmel : MISO, 2013.

in 2016, based on the amount of MISO generation that cleared PJM's capacity market for that year.[23]

- MISO is also cross-checking nameplate and reported capacity with each generation resource owner. As reported by SNL Energy, MISO has a 6 GW gap between the nameplate capacity of the generation connected to its system and the amount they actually produce.[24] According to planning staff from MISO, this is attributable to generators having interconnection rights for less than their nameplate capacity. MISO staff explain that MISO is reviewing ways that it could grant additional firm interconnection rights to these generators.[25]

One of MISO's other data-gathering activities has been regularly tracking the amount of expected generator retirements and retrofits in anticipation of Mercury and Air Toxics Standards (MATS), which will begin to go into effect in 2015. Since the end of 2011, MISO has been sending a quarterly survey to generation asset owners (Quarterly EPA Survey) to track their plans for complying with the regulations. These surveys identify the 66.2 GW of coal-fired generation in MISO North and Central, all of which:

- require no action to comply with regulation,
- anticipate installing controls,
- have already completed installation of controls,
- plan to retire, and
- are still to be decided.[26]

It is important to note that retirements and retrofits reported in the Quarterly EPA Survey are being driven by compliance with MATS.[27] The effects of CSAPR and EPA's proposed greenhouse gas regulations will be discussed further in Section 5 but are not yet included in the current EPA Surveys to date.

Exhibit 2-1 shows that as recently as the fourth quarter of 2014, 16.4 GW of generation in MISO required no action at all in order to comply with the MATS regulation, but that nearly 50 GW do require action. Exhibit 2-2 shows the majority of generation requiring action – 40 GW – has chosen to retrofit. As of the fourth quarter of 2014, 8 GW planned to retire and 0.9 GW still had not committed to a course of action.

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[23] **Midcontinent Independent System Operator, Inc. (MISO).** Supply Adequacy Working Group Meeting Materials. [Online] July 10, 2014. [Cited: July 11, 2014] https://www.misoenergy.org/Library/MeetingMaterials/Pages/SAWG.aspx.

[24] **Wolff, Eric.** MISO pats its pockets for missing megawatts. *SNL News.* [Online] February 11, 2014. [Cited: July 7, 2014] http://www.snl.com/interactivex/article.aspx?id=26845832&KPLT=6.

[25] MISO planning staff discussion with NETL staff, February 13, 2015. See also section 6.4 of **Midcontinent Independent System Operator, Inc. (MISO).** 2014 Transmission Expansion Plan. Carmel : MISO, 2013.

[26] **Midcontinent Independent System Operator, Inc. (MISO).** EPA Surveys for Asset Owners. [Online] [Cited: January 30, 2015] https://www.misoenergy.org/WhatWeDo/EPARegulations/Pages/EPAStudies.aspx.

[27] **Environmental Protection Agency (EPA).** Mercury and Air Toxics Standards. Reconsideration of Certain New Source Issues: National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units. *Federal Register* April 24, 2013.

Exhibit 2-1 Results of Quarterly EPA Survey: total coal generation

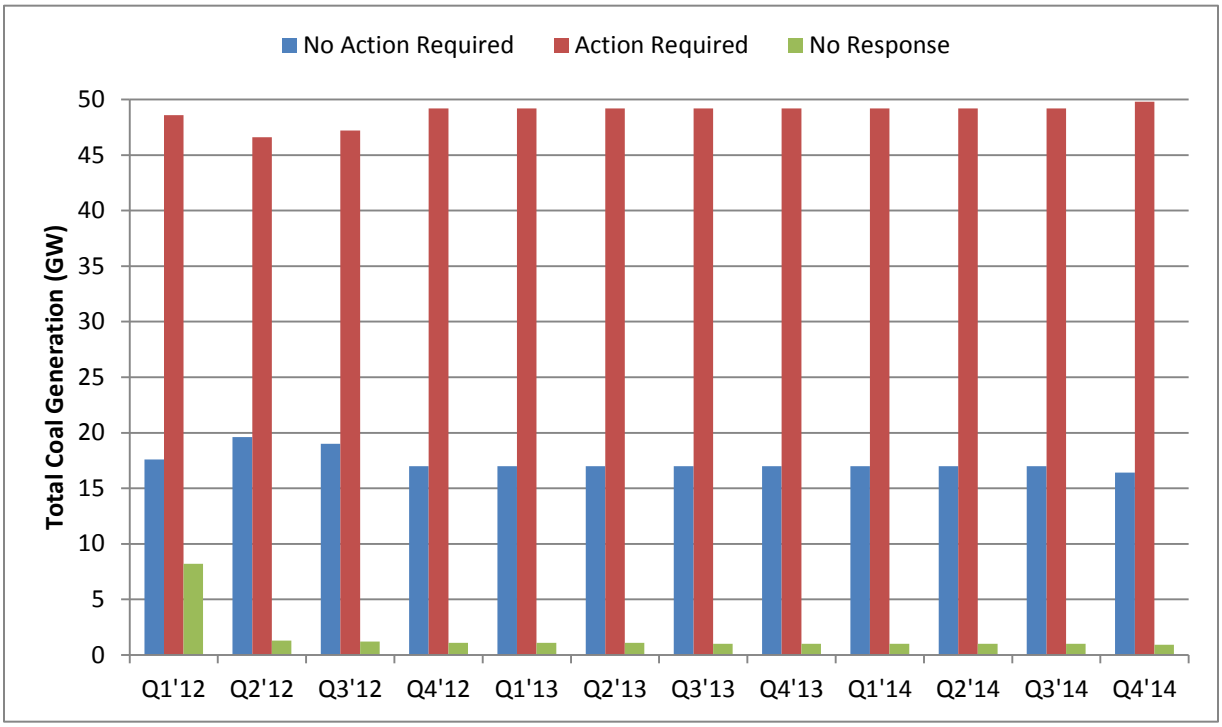
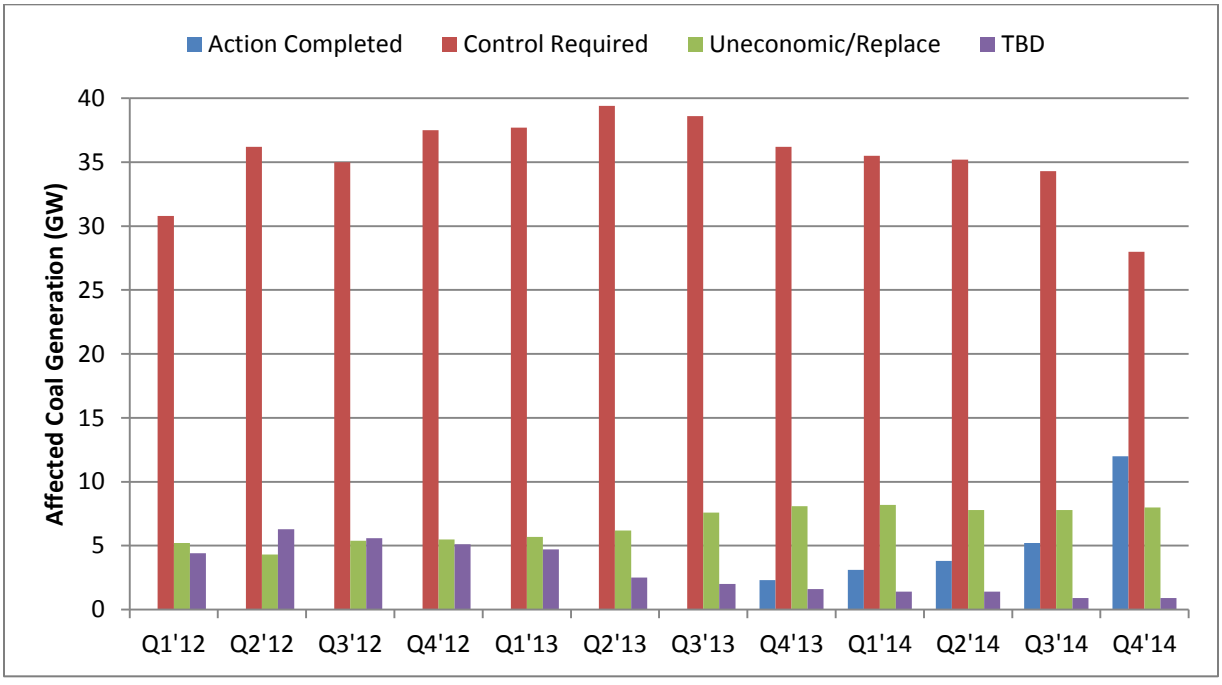


Exhibit 2-2 Results of Quarterly EPA Survey: affected coal generation



Further, only 12 GW of 39 GW requiring retrofits have been completed through the fourth quarter of 2014. Coordinating the number of outages needed to retrofit the remaining 28 GW by the 2015 deadline (2016 for those granted a one-year compliance extension by EPA) could prove challenging to MISO at a time when it is also dealing with significant retirements. In a 2012

study commissioned by MISO, the Brattle Group analyzed generators' ability to complete retrofits by the 2015 deadline, as well as MISO's ability to absorb all of the outages necessary to complete the retrofits. The study concluded that the industry would very likely run into delays and bottlenecks, and that MISO could experience operation challenges in managing the outages.[28] These predictions have proven to be true, because the Quarterly EPA Survey reports that 84 of the 91 generators (21 GW of 39 GW) that are planning retrofits have sought a one-year extension, and MISO has extended its traditional six-month spring and fall outage season to a nine-month spring, winter, and fall outage season.[26]

Because the Quarterly EPA Survey only covers coal-fired generation, it does not capture all of MISO's power plant retirements. The 2013 MTEP projected a total of 10.4 GW of retiring generation by 2016, based on submitted retirement requests and the results of the Quarterly EPA Survey. [26] Included in the 2013 MTEP, but not included in the Quarterly EPA Survey, are 1.8 GW, which mostly consist of older gas-fired units retiring for economic reasons.

3 Transmission and Generation Analysis

The transmission system can either aid or exacerbate MISO's resource adequacy issues. For instance, a robust transmission system could allow MISO to import sufficient capacity to meet its projected shortfall. However, instead of importing from neighboring systems, capacity located within MISO is being committed to export power to serve PJM's load through PJM's capacity market. Additionally, MISO is addressing problems involving transmission constrained areas by increasingly relying on System Support Resource (SSR) agreements, which can prevent generation plants from retiring. The following section explores different ways that the transmission system might affect or be affected by a generation shortfall in MISO.

3.1 System Support Resources

MISO is known to have transmission-constrained areas where congestion problems may be intensified by certain generator retirements. This is evidenced by the number of SSR agreements that MISO has entered into recently; SSR agreements prevent a generator from retiring, since to do so would negatively impact the reliability of the transmission system.

Before a generating unit can retire or suspend operations, the owner must submit a retirement request to MISO. MISO then performs a reliability evaluation of the generating unit retirement's impact on the transmission system. If MISO finds that the unit is needed for reliability operations, they will designate that unit as an SSR. MISO then looks for an alternative to continued operation of the unit, such as a transmission upgrade or new generation resource that will alleviate the reliability impact of the unit's retirement. If MISO is unable to implement such an alternative prior to the unit's proposed retirement date, MISO can negotiate with the unit owner to seek continued operation under an SSR agreement. The SSR agreement is for a defined period and generally ends once the alternative solution to the unit's operation has been implemented. MISO adopted this program as a stopgap measure to maintain critical system reliability; increased use of this program since 2012 indicates that generator retirements are already having a negative effect on MISO's ability to maintain grid reliability.

[28] **Brattle Group.** Supply Chain and Outage Analysis of MISO Coal Retrofits for MATS. Carmel : Midcontinent Independent System Operator, Inc. (MISO), 2012.

Exhibit 3-1 Plants with SSR agreements

Plant Name	Ownership	Plant Size (units)	Age (years)	Transmission Zone	Local Resource Zone	Plant Type
Escanaba (MI)[29]	City of Escanaba, MI	25 MW (2)	56	Upper Peninsula	2	Steam Coal
Harbor Beach (MI)[30]	DTE Electric Company	103 MW (1)	45	Alliant East	2	
Coleman (KY)[31]	Big Rivers Electric Cooperative	443 MW (3)	44	Big Rivers	6	Steam Coal
Presque Isle (MI)[32]	Wisconsin Electric Power Company	334 MW (5)	37	Upper Peninsula	2	
Edwards (IL)[33]	Ameren Energy Marketing	90 MW (1)	54	Ameren	4	
Straits (MI)[34]	Consumers Electric Company	10 MW (1)	45	Michigan Transmission	7	Gas Combustion
Gaylord (MI)[35]		40 MW (3)	48	Michigan Transmission	7	
White Pine (MI)[36]	White Pine Electric Power	20 MW (1)	60	Alliant East	2	Coal converted to gas

Although MISO has had the ability to designate SSRs since 2004, it did not do so until 2012. Since then, MISO has designated 8 generation resources as SSRs, totaling 1,065 MW, in order to

[29] **Federal Energy Regulatory Commission (FERC)**. Order Conditionally Accepting Tariff Filings. Docket No. ER14-2176-000. [Online] August 12, 2014. [Cited: November 3, 2014] http://www.ferc.gov/CalendarFiles/20140812165700-ER14-2176-000.pdf

[30] **Federal Energy Regulatory Commission (FERC)**. Order on Accepting Proposed Agreement and Conditionally Accepting Proposed Rate Schedule. Docket No. ER13-1225-000. [Online] August 26, 2013. [Cited: November 3, 2014] http://www.ferc.gov/CalendarFiles/20130826151719-ER13-1225-000.pdf

[31] **Federal Energy Regulatory Commission (FERC)**. Order on Accepting and Suspending Tariff Filings Subject to Refund and Further Commission Order. Docket No. ER14-292-000. [Online] December 30, 2013. [Cited: November 3, 2014] http://www.ferc.gov/CalendarFiles/20131230164254-ER14-292-000.pdf

[32] **Federal Energy Regulatory Commission (FERC)**. Order on Complaint, Tariff Filings, and Rehearing, and Establishing Hearing and Settlement Procedures. Docket No. ER14-1242-000. [Online] July 29, 2014. [Cited: November 3, 2014] http://www.ferc.gov/CalendarFiles/20140729142046-ER14-1242-000.pdf

[33] **Federal Energy Regulatory Commission (FERC)**. Order on Accepting and Suspending Tariff Filings Subject to Refund and Further Commission Order. Docket No. ER14-1210-000. [Online] March 31, 2014. [Cited: November 3, 2014] http://www.ferc.gov/CalendarFiles/20140331143705-ER14-1210-000.pdf

[34] **Midcontinent Independent System Operator, Inc. (MISO).** Midcontinent Independent System Operator, Inc. Amendment Filing of Request for Waiver and Notice of Termination Regarding an SSR Agreement for the Straits SSR Unit No. 1 (Service Agreement No. 6504, originally Submitted in Docket No. ER14-112-000) Docket No. ER14-2617-000. [Online] September 15, 2014. [Cited: November 3, 2014] https://www.misoenergy.org/Library/Repository/Tariff/FERC%20Filings/2014-09-15%20Docket%20No.%20ER14-2617-001.pdf

[35] **Midcontinent Independent System Operator, Inc. (MISO).** Midcontinent Independent System Operator, Inc. Amendment Filing of Request for Waiver and Notice of Termination Regarding an SSR Agreement for the Gaylord SSR Units No. 1-3 (Service Agreement No. 6503, originally Submitted in Docket No. ER14-109-000) Docket No. ER14-2615-000. [Online] September 15, 2014. [Cited: November 3, 2014] https://www.misoenergy.org/Library/Repository/Tariff/FERC%20Filings/2014-09-15%20Docket%20No.%20ER14-2615-001.pdf

[36] **Federal Energy Regulatory Commission (FERC)**. Order on Accepting and Suspending Tariff Filings Subject to Refund and Further Commission Order. Docket No. ER14-1724-000. [Online] June 13, 2014. [Cited: November 3, 2014] http://www.ferc.gov/CalendarFiles/20140613165103-ER14-1724-000.pdf

prevent them from retiring or suspending operations.[37] The majority of these are aging coal-fired power plants, as shown in Exhibit 3-1. For each of these SSRs, MISO is required to find a reliability solution that would allow the generation unit to retire or suspend operations once the solution is implemented. Generally, MISO has found that the SSRs are necessary because the generation unit is located in a transmission-constrained area, and a transmission upgrade is required to mitigate the reliability concern in order to allow the unit to retire/suspend operations.

3.2 Zonal Self-Sufficiency Analysis[38]

Each year, MISO performs an analysis as part of the planning process to determine the level of generation required by the RTO to maintain a certain planning reserve margin (PRM) in anticipation of a 1-in-10 system event. This analysis is based on the installed capacity (ICAP), the firm external contracts, a 1-in-10 event adjustment, and the forecasted peak system demand. By extending these targets, shown in Exhibit 3-2, across each transmission zone and comparing those with the minimum anticipated reserve margin for each zone, it is possible to determine the generation shortfall for each zone and when each zone will experience a shortfall. Based on the installed generation, as well as imports and exports from a zone, a zone is considered either self-sufficient or experiencing shortfalls. The calculated shortfalls were determined by the difference between the PRM target and zonal reserve and then working backward through the NERC reserve margin formula with the result shown in Exhibit 3-2. The anticipated reserve for each zone was determined using the NERC reserve margin formula:

$$RM = \frac{ICAP - Net\ Internal\ Demand}{Net\ Internal\ Demand}, \text{ where}$$

$$Net\ Internal\ Demand = Peak\ Demand - Demand\ Resources$$

The values used to inform this portion of the analysis, shown in Appendix C, were derived using Ventyx's PROMOD 11.1 and included de-rated values for wind and solar resources, 14.1 percent and 23.5 percent, respectively.

[37] This information was compiled from MISO's SSR filings with FERC.

[38] It is important to note that the analysis in this sub-section is blind to transmission interchange between each zone; the effect of interchange is examined in Section 3.3.

Exhibit 3-2 MISO ICAP PRM targets (2014-2024)[39,40,41]

Year	2013 LOLE Study	2014 LOLE Study	2015 LOLE Study
2014	14.1%	14.8%	NS
2015	14.0%	14.9%	14.3%
2016	13.9%	15.0%	14.4%
2017	13.8%	15.1%	14.5%
2018	13.7%	15.1%	14.5%
2019	13.7%	15.6%	14.4%
2020	13.6%	16.0%	14.4%
2021	13.5%	16.4%	14.3%
2022	13.4%	16.8%	14.3%
2023	NS	17.3%	14.2%
2024	NS	NS	14.2%

NS = Not Studied

Comparing the values that were generated using this method with the ICAP PRM values reveals that the volume of ICAP self-sufficiency shortfalls and the impacted shortfall zones varies from year to year. Comparing the results generated from the 2013, 2014, and 2015 Loss of Load Expectation (LOLE) studies[39,40,41] reveals that six of the nine MISO local resource zones (LRZ) will have an ICAP self-sufficiency shortfall by 2023, with shortfall volumes varying based on the PRM target and included anticipated certain capacity.[42,43] The analysis indicates that the entirety of MISO will experience an ICAP shortfall beginning in 2017 (1,218 MW/466 MW) using the 2014 and 2015 PRM targets, or 2018 (2,576 MW) using the 2013 PRM target. Segmenting MISO into its larger operating regions, MISO North and Central will experience a shortfall beginning in 2016 using each LOLE study's PRM target – 3,789 MW (2013), 4,808 MW (2014), 4,252 MW (2015) – which creates a potential for increased reliability issues from a self-sufficiency perspective. MISO South will not experience a shortfall, nor will any of its constituent parts.[44] The differences between the MISO values shown in Exhibit 3-3 and MISO North and Central values shown in Exhibit 3-4 are indicative of the impact of generation surpluses in MISO South on the MISO footprint reserve.

[39] **Midcontinent Independent System Operator, Inc. (MISO).** Resource Adequacy Studies: 2013 Loss of Load Expectation (LOLE) Study. [Online] November 1, 2012. [Cited: January 14, 2014] https://www.misoenergy.org/_layouts/MISO/ECM/Redirect.aspx?ID=140974

[40] **Midcontinent Independent System Operator, Inc. (MISO).** Resource Adequacy Studies: 2014 Loss of Load Expectation (LOLE) Study. [Online] November 1, 2013. [Cited: January 14, 2014] https://www.misoenergy.org/_layouts/MISO/ECM/Redirect.aspx?ID=162890

[41] **Midcontinent Independent System Operator, Inc. (MISO).** Resource Adequacy Studies: 2015 Loss of Load Expectation (LOLE) Study. [Online] December 30,2014. [Cited: January 14, 2014] https://www.misoenergy.org/_layouts/MISO/ECM/Redirect.aspx?ID=187288

[42] Certain capacity includes units that are operating, permitted, or under construction. Capacity that does not fall into these categories would be considered speculative and could include capacity that is proposed pending approval or under feasibility study.

[43] Certain capacity is adjusted for each of the evaluation years to remove capacity retiring and capacity entering service prior to the annual system peak demand.

[44] MISO South was not included in the 2013 LOLE study because it did not achieve MISO integration before the study was completed.

Exhibit 3-3 MISO ICAP shortfall[45]

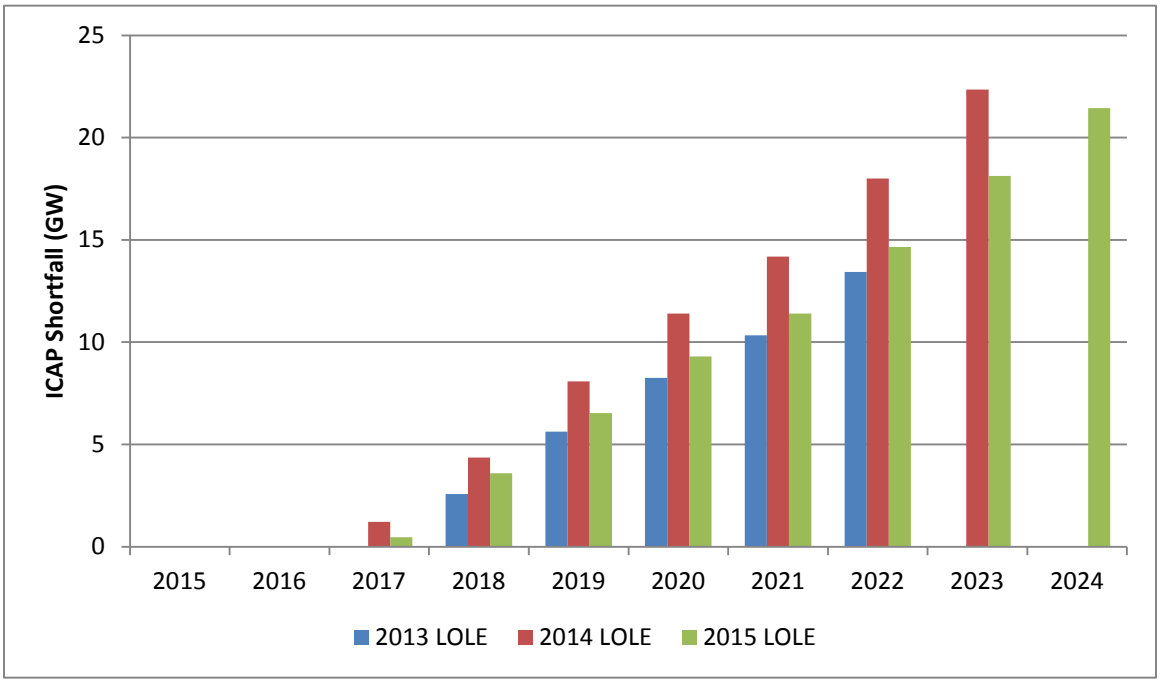
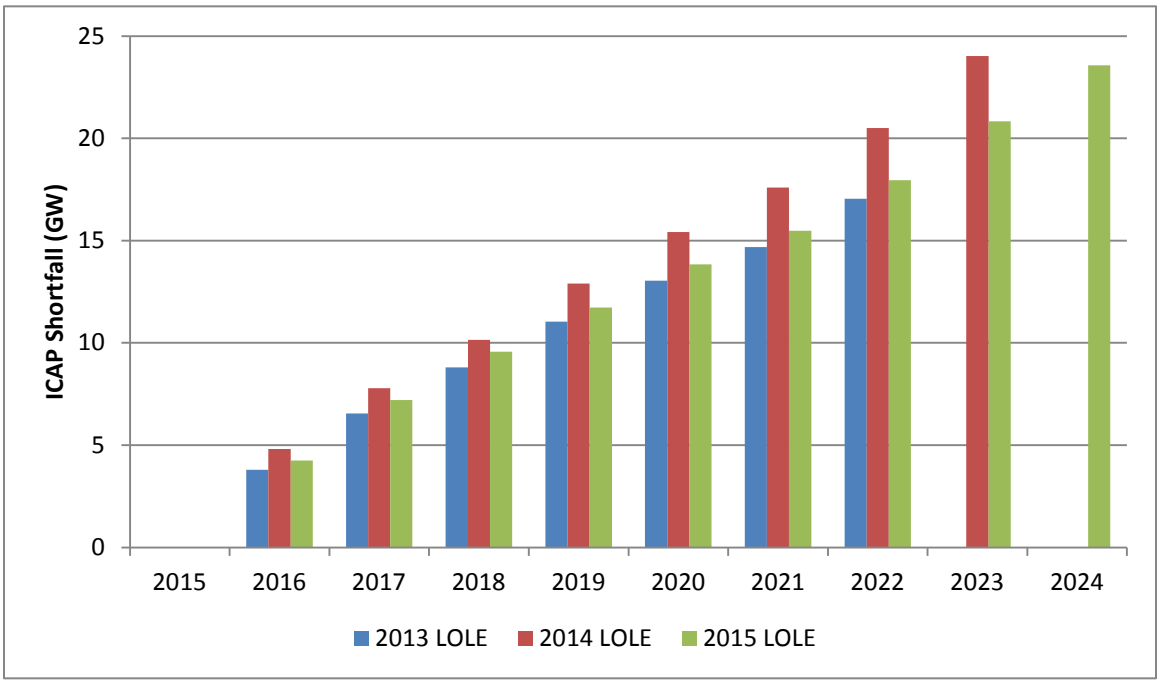


Exhibit 3-4 MISO North and Central ICAP shortfall[45]



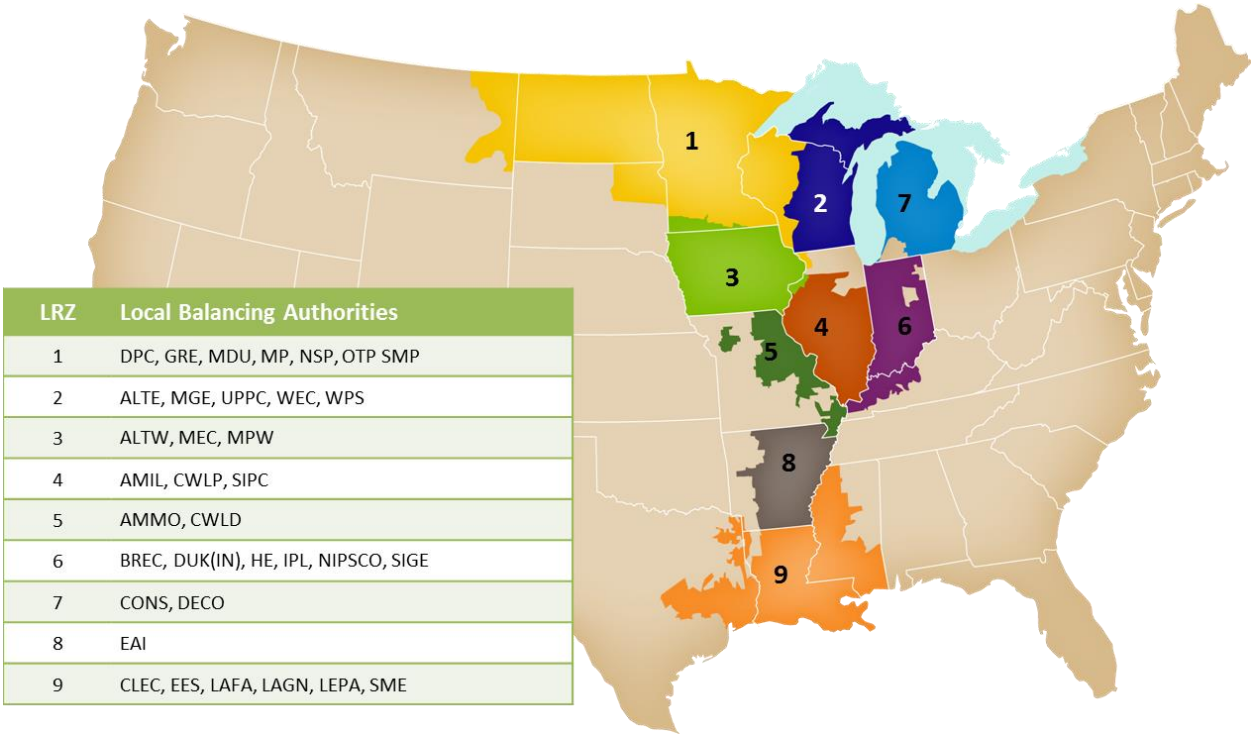
[45] 2023 and 2024 were not studied in the 2013 LOLE Study; 2024 was not studied in the 2014 LOLE Study.

Zonally, MISO North and Central are comprised of the LRZs that constituted the MISO footprint prior to the December 2013 integration of Entergy and the other members of MISO South. Examining these zones separately reveals the first occurrence and severity of each zone's ICAP PRM self-sufficiency shortfall. LRZs 1, 6, and 7 are expected to experience self-sufficiency shortfalls beginning in 2015 and increasing through 2024. The shortfall in LRZ 1 is a continued and increased shortfall from 2014, which was identified under all LOLE Study PRM targets. Using the 2015 LOLE Study PRM target, both LRZ 1 and 7 vie for the most severe shortfalls by 2024 at 8,613 MW and 7,756 MW, respectively. LRZs 2, 3, and 6 each also require additional capacity to cover shortfalls under each of the LOLE Study PRM targets. By 2024, these zones are expected to require 2,904 MW, 2,081 MW, and 3,828 MW, respectively. LRZ 9 is expected to experience its first shortfall in 2023 or 2024, depending on whether the 2014 or 2015 PRM target is used (567 MW or 172 MW). LRZs 4, 5, and 8 are the only zones that do not require additional capacity using any of the studied PRM targets. Appendix A includes time-trend charts that illustrate the shortfalls projected for LRZ, except those without a shortfall, based on each LOLE study PRM target.

3.3 Capacity Import/Export Limit Analysis

Expanding the analysis of Section 3.2 to determine the total quantity of stranded or shortfall generation in MISO and its constituent local resource zones requires the inclusion of a capacity import limit (CIL) and a capacity export limit (CEL). Exhibit 3-5 illustrates the LRZ layout on the MISO footprint, while Exhibit 3-6 shows the limits for each zone from the 2013, 2014, and 2015 LOLE studies.

Exhibit 3-5 MISO local resource zones[41]



LRZ	Local Balancing Authorities
1	DPC, GRE, MDU, MP, NSP, OTP SMP
2	ALTE, MGE, UPPC, WEC, WPS
3	ALTW, MEC, MPW
4	AMIL, CWLP, SIPC
5	AMMO, CWLD
6	BREC, DUK(IN), HE, IPL, NIPSCO, SIGE
7	CONS, DECO
8	EAI
9	CLEC, EES, LAFA, LAGN, LEPA, SME

Used with permission from *MISO*

Exhibit 3-6 Local resource zone capacity import/export limits[39,40,41]

LRZ	2013 LOLE Study		2014 LOLE Study		2015 LOLE Study	
	CIL (MW)	CEL (MW)	CIL (MW)	CEL (MW)	CIL (MW)	CEL (MW)
1	4,085	1,416	4,347	286	3,735	604
2	4,144	1,766	3,083	1,924	2,903	1,516
3	3,717	1,612	1,591	1,875	1,972	1,477
4	6,614	2,230	3,025	1,961	3,130	4,125
5	5,035	1,616	5,273	1,350	3,899	0
6	6,838	3,432	4,834	2,246	5,649	2,930
7	4,576	4,306	3,884	4,517	3,813	4,804
8	NS	NS	1,602	3,080	2,074	3,022
9	NS	NS	3,585	3,616	3,320	3,239

Finally, generation shortfalls were determined by subtracting the CIL from the shortfalls identified in Section 3.2. This report determines that LRZs 1, 3, and 7 remain with a capacity shortfall through 2023 once transmission interchange is included with the 2014 LOLE PRM levels, or LRZs 1, 2, 3, and 7 when the 2015 LOLE PRM levels are included. The shortfalls in LRZs 1 and 7 begin in 2017 at 15 MW and 460 MW, respectively, and grow each year, reaching 4,100 MW and 4,051 MW by 2023 using the 2014 LOLE PRM levels. Applying the 2015 LOLE PRM levels, the shortfalls are worsened beginning at 524 MW and 405 MW and ending at 4,878 MW and 3,943 MW by 2024, respectively. For the full MISO footprint, shortfalls were identified beginning in 2020 under both the 2014 and 2015 LOLE PRM levels. Using the 2014 levels, an initial shortfall of 2,699 MW was identified; while using the 2015 levels, the initial shortfall was reduced to 1,635 MW. Under both levels, MISO is expected to experience a shortfall of 13,785 MW by 2024. The overall MISO footprint shortfall is driven by the shortfalls occurring in the MISO North Central component LRZs. Looking specifically at this sub-region reveals an expectation of shortfall beginning in 2018 using the 2014 and 2015 LOLE PRM levels. Under the 2014 levels, the shortfall is expected to begin at 942 MW and quickly escalate to 14,817 MW by 2023. Using the 2015 levels, the shortfall is expected to begin at a lower level (365 MW) and escalate more quickly, reaching 14,373 MW by 2024. Under all levels, MISO South is expected to have sufficient installed capacity and transmission to avoid shortfall issues.

Excess capacity was identified by reversing the shortfall calculation used in Section 3.2 to determine the excess reserve margin above the PRM. This process determined that, while the values decrease significantly due to retirements and load growth, four LRZ zones have at least one year with excess capacity in one or more of the three analyzed PRM levels. Netting these values less the CEL is equivalent to the quantity of stranded generation within a zone. This revealed that three of the nine MISO transmission zones – LRZ 5, 8, and 9 – have multiple years with stranded capacity (Exhibit 3-7, Exhibit 3-8, Exhibit 3-9) using the analyzed PRM cases, while LRZ 2 has one year of stranded capacity. Capacity is considered stranded if a zone has excess generation that is not being exported, usually due to transmission constraints. It is

unexpected that this analysis reveals stranded capacity in LRZ 2, because multiple SSR agreements have been entered in this zone. This capacity is an indicator that this LRZ is transmission constrained.

Exhibit 3-7 Local Resource Zone 5 stranded capacity

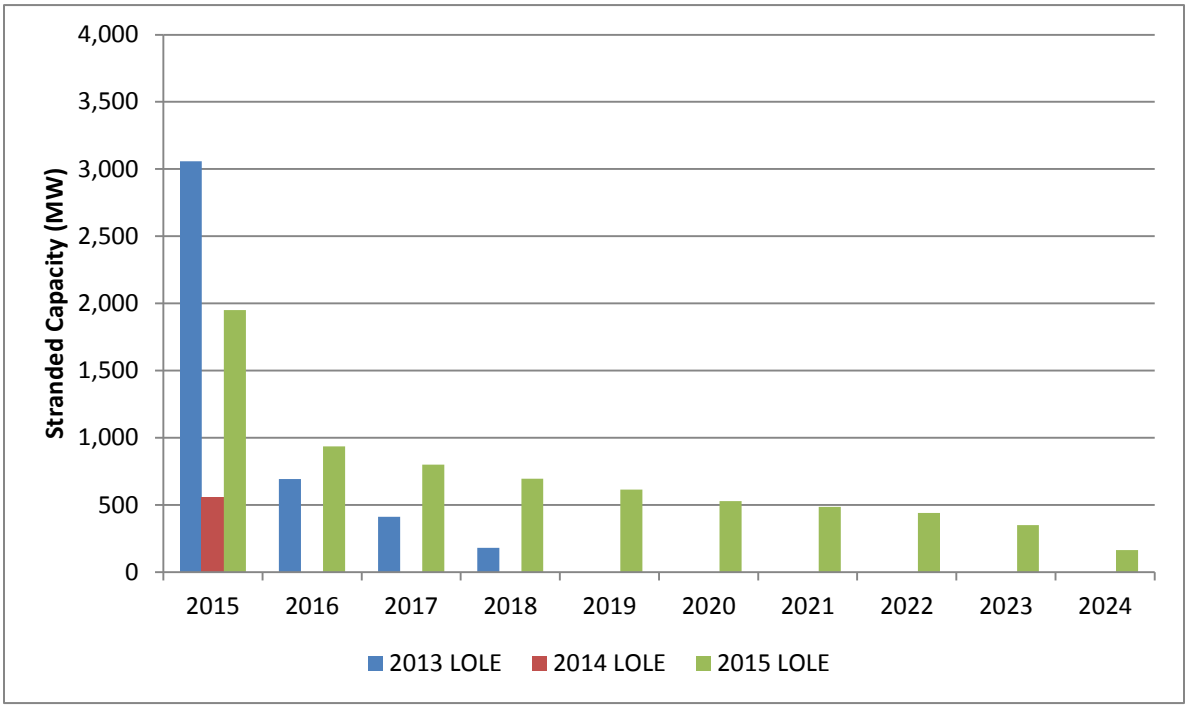


Exhibit 3-8 Local Resource Zone 8 stranded capacity[46]

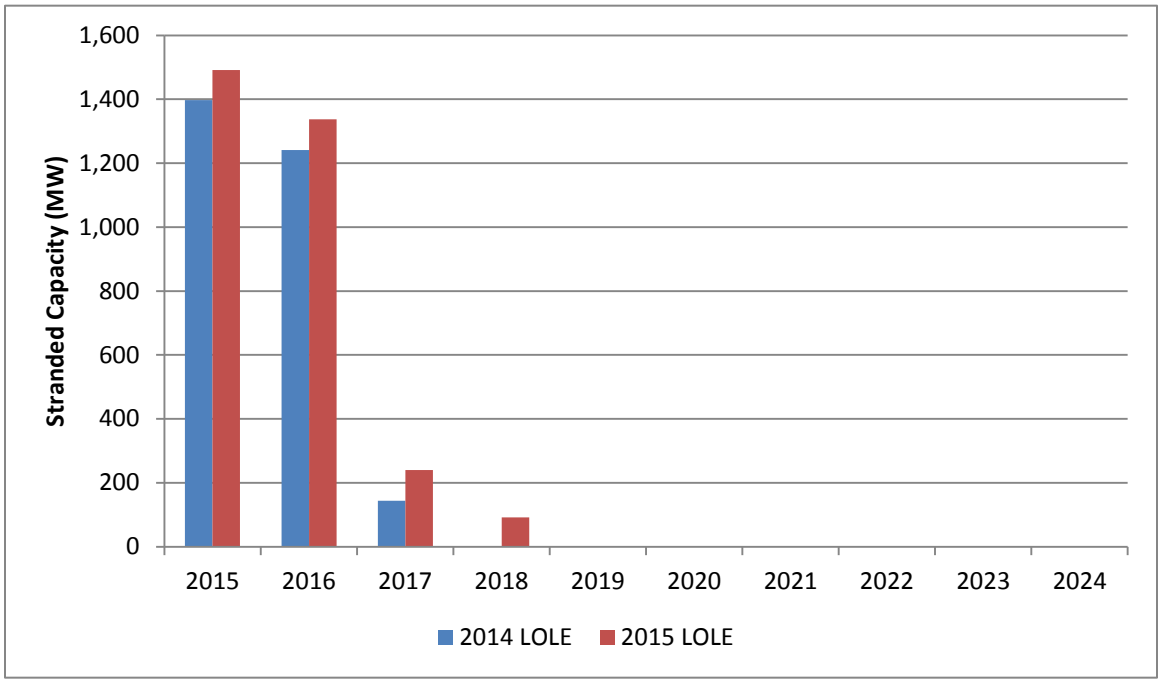
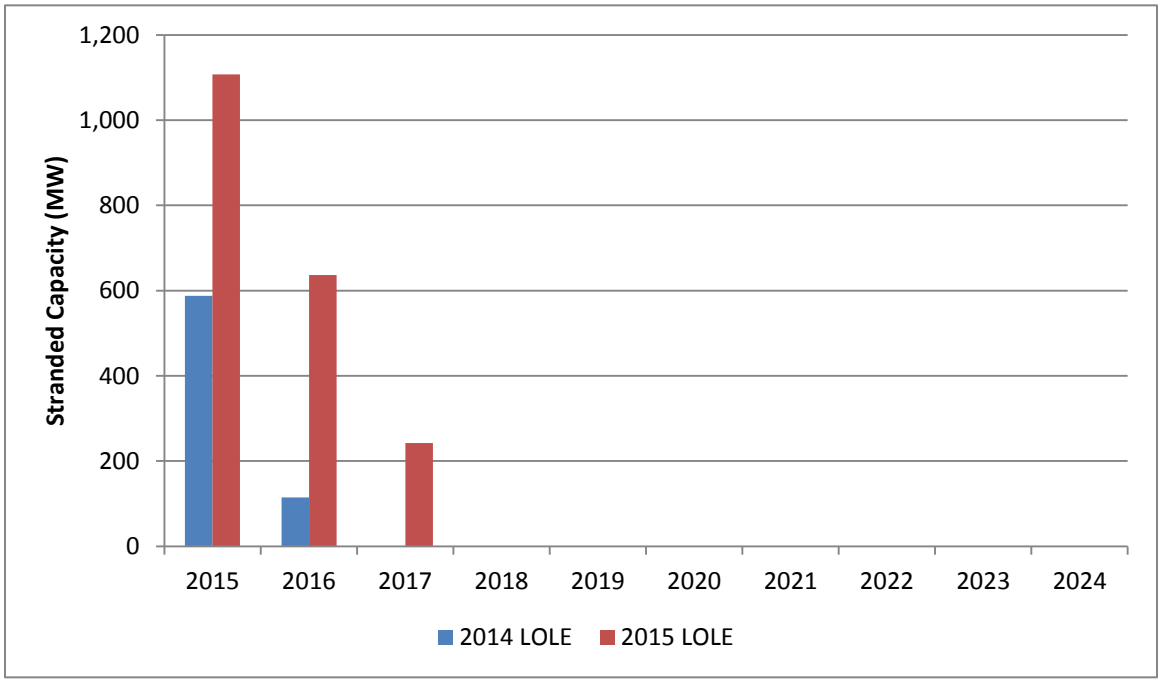


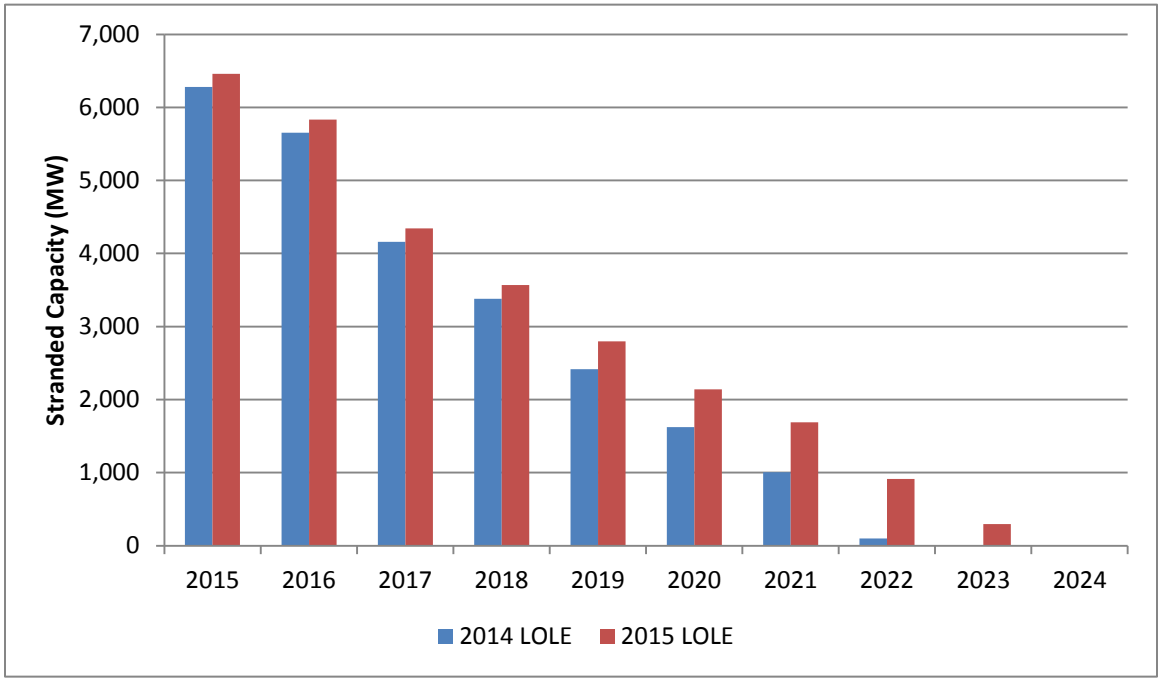
Exhibit 3-9 Local Resource Zone 9 stranded capacity[46]



[46] LRZ 8 and 9 were not included in the 2013 LOLE Study because they did not exist until after the December 2013 integration of Entergy, Central Louisiana Electric Company, South Mississippi Electric Power Association, Lafayette Utilities, Louisiana Energy and Power Authority, and Louisiana Generating.

Looking at the data from the sub-regional and full footprint levels reveals that only MISO South will have significant quantities of stranded capacity, which diminishes over time due to retirements and load growth. Neither MISO North Central nor the entire MISO footprint is expected to have stranded capacity, which is expected with the shortfalls that are projected by the self-sufficiency and capacity import limit analyses.

Exhibit 3-10 MISO South sub-region stranded capacity[47]



3.4 MISO and PJM Seams Issues

Because MISO and PJM have a highly integrated seam, power flows between them can have a significant impact on their respective transmission systems, as well as their potential access to capacity resources. PJM and MISO have been working together on the MISO/PJM Joint and Common Market (JCM) Initiative, with a Joint Operating Agreement (JOA) for market-to-market operations established in 2005.[48] The stated objective of the JCM is to coordinate the efforts and impacts of a shared market that includes the area covered by both PJM and MISO. The main approaches that the JOA requires in order to be successful include stakeholder involvement, regulatory buy-in, incremental implementation, and leveraging of technology.[48]

MISO and PJM are working to develop requirements for exchanging day-ahead data in order to coordinate the forward markets, as well as a cost-benefit analysis of the firm flow entitlement

[47] The MISO South sub-region did not exist until after the December 2013 integration of Entergy and others into the MISO system, and was therefore not included in the 2013 LOLE Study.

[48] **PJM Interconnection and Midcontinent Independent System Operator, Inc. (MISO).** PJM-MISO Joint and Common Market White Paper. *PJM-MISO Joint and Common Market Initiative*. [Online] July 15, 2005. [Cited: July 10, 2014] http://www.miso-pjm.com/~/media/pjm-jointcommon/downloads/20050715-pjm-miso-jointandcommon-white-paper.ashx.

(FFE) limits.[49] These limits are in place to restrict both RTOs' external generation exposure, thus reducing the potential for generation deliverability issues beyond the control of the RTO; e.g., curtailment of key PJM resource within the MISO footprint or vice versa. Both PJM and MISO have analyzed the operation of the Ontario-Michigan Phase Angle Regulator (PAR) transformers from the period of August 2012 to August 2013 and have planned different methods for modeling the market flows and performing the calculations. PJM, MISO, and SPP are working on a joint report that analyzes commercial market flow options to be shared with their stakeholders upon completion, which was scheduled for late 2014.[48] A workshop on interchange optimization that took place in April 2014 focused on the background information, the results of a benefit analysis of data from 2013, an overview of a proposal for coordinated transaction scheduling between PJM and MISO, an overview of possible changes to rules for settling markets, and the timeline moving forward. [48] Solutions for reducing the current congestion of transmission between the MISO and PJM seam have been reviewed and analyzed for potential costs and benefits moving forward. Of the 77 proposed solutions, 19 show benefits for both PJM and MISO, 29 show benefits for MISO but not for PJM, and 29 show benefits for PJM but not for MISO. Overall, three projects of the 19 mutually beneficial projects have sufficient benefit-to-cost ratios to be taken under further review.[48]

Proposed revisions to PJM's "Reliability Assurance Agreement (RAA) among Load Serving Entities in the PJM Region and the PJM Open Access Transmission Tariff (OATT)" were approved by FERC and took effect on January 31, 2014. [48,50] These revisions proposed setting the PJM RTO CIL at 6,000 MW.[51] During the proceedings before FERC, the MISO Market Monitor objected to the CIL, arguing that the proposed tariff revision afforded PJM comprehensive discretion in determining and applying the CIL.[50] The MISO Market Monitor also took issue with PJM's defined external source zones for planning, stating that they were arbitrary and inconsistent with how energy resources would be delivered from MISO and did not take into account any input from MISO.[49]

Another accepted revision to the RAA that the MISO Market Monitor disagreed with was the explanation that the CIL is the maximum amount of capacity that the energy transmission system can support minus the capacity benefit margin, which is currently set at 3,500 MW by PJM.[49] The MISO argument stated that having so much possible export capacity from MISO set aside for the capacity benefit margin reduces the efficiency and reliability of the bulk power system. In the end, FERC rejected any call for the revised proposal to be rejected or held in abeyance while additional revisions were discussed.[49]

The Organization of MISO States and the Organization of PJM States, Inc. performed an analysis of concerns regarding capacity deliverability in the seam between MISO and PJM.[52]

[49] **PJM Interconnection and Midcontinent Independent System Operator, Inc. (MISO).** PJM/MISO Joint and Common Market Initiative Meeting. *PJM/MISO Joint and Common Market Initiative.* [Online] May 28, 2014. [Cited: July 10, 2014] http://www.pjm.com/committees-and-groups/stakeholder-meetings/stakeholder-groups/pjm-miso-joint-common.aspx.

[50] **Federal Energy Regulatory Commission (FERC).** Order Accepting Tariff Revisions. *FERC Orders and Notices.* [Online] April 22, 2014. [Cited: July 10, 2014] http://www.pjm.com/~/media/documents/ferc/2014-orders/20140422-er14-503-000%20and%20er-14-503-001.ashx.

[51] This CIL is a separate and unrelated value from the values used in the Section 3.3 analysis. This value is the PJM RTO limit, while the Section 3.3 values are unique for each MISO transmission zone. The PJM TRO limit is relevant for discussion in this text because it represents a restriction on flows from generators in MISO who may bid into the PJM capacity market.

[52] **PJM Interconnection and Midcontinent Independent System Operator, Inc. (MISO).** Draft Capacity Deliverability Fact Finding Summary Report. *PJM/MISO Joint and Common Market Initiative.* [Online] April 11, 2014. [Cited: July 10, 2014]

There are two tasks in the fact-finding analysis. The first covers the identification of a procedure to determine the combined capacity deliverability for the service area covered by PJM and MISO. The second is estimating the "total capacity transfer capability" between the two RTOs in both directions. The analysis summarized a number of findings, including that limits should be set within the limits of the system as well as procedures that respect total capacity commitment, and that plans for adjusting and expanding transmission systems must take auction commitment into account. Each of the RTOs also conducted an independent analysis of the independent capacity deliverability for their own RTO and the other RTO, as well as the joint capacity deliverability of the combined RTOs, the results of which can be seen in Exhibit 3-11.

Exhibit 3-11 PJM and MISO analysis results for joint capacity deliverability[52]

		Generation (MW)	Approximate Energy Resources (MW)	Tested Network Resources Level (MW)	Calculated Restricted Network Resources Level (MW)	Calculated Deliverable Capacity Resources (MW)	Calculated Deliverable Capacity Resources (% of Tested Network Resources)
MISO Analysis Results	MISO Generation	190,405	22,940	167,465	7,358	160,107	95.61%
	PJM Generation	233,612	21,107	212,505	9	212.496	100.00%
	MISO+PJM Joint Deliverability	424.017	44,047	379,970	7,367	372,603	98.06%
PJM Analysis Results	MISO Generation	167,079	0	167,079	10,359	156,720	93.8%
	PJM Generation	231,569	21,107	210,462	1,684	208,778	99.2%
	MISO+PJM Joint Deliverability	398,648	21,107	377,541	12,044	365,497	96.8%

Differences in calculated values between each of the analyses are the result of different calculation methodologies, network topologies, and market efficiency assumptions.

http://www.pjm.com/~/media/committees-groups/stakeholder-meetings/pjm-miso-joint-common/20140414/20140414-draft-capacity-deliverability-fact-finding-summary-report.ashx.

4 Responsibility of LSEs

MISO has defined the responsibilities of LSEs, which are enforced by NERC, to ensure the reliable operation of the grid. These responsibilities do not include an obligation to obtain adequate generation to serve load. The obligation to serve load remains the responsibility of the LSEs. In most MISO states, jurisdictional utilities are required to submit Integrated Resource Plans (IRP), which must explain how the utility plans to use existing and future resources to meet customer demand. These IRPs are subject to approval by the state Public Service Commission (PSC). Exhibit 4-1 shows the MISO North and MISO Central states and whether or not they have IRPs or similar programs.

Exhibit 4-1 MISO states and IRP requirements

State	IRP	Notes
Illinois	No	Electricity Procurement Plan (EPP) is similar to an IRP. Rather than each individual utility providing an IRP, however, the EPP is prepared to serve all retail customers within the state. The 2014 EPP recommends that utilities procure additional resources to address forecasted shortfalls and risks associated with load switching.[53]
Indiana	Yes	Indiana requires regulated utilities to develop an IRP every two years that documents how they plan to meet future customer demand.[54,55]
Iowa	No	Iowa utilities are not required to engage in a traditional IRP process. They are only required to submit an annual report on their energy efficiency plan to the Iowa Utilities Board.[56]
Kentucky	Yes	Utilities submit triennial IRPs to the Kentucky Public Service Commission.[57]
Michigan	Yes	Michigan's Public Act 286 of 2008 requires that utilities submit an IRP when seeking a Certificate of Necessity from the Michigan Public Service Commission.[58,59,60]
Minnesota	Yes	The Minnesota Public Utility Commission requires utilities to submit an IRP biennially that ensures that the utility can meet its customers' needs reliably and efficiently.[61]
Missouri	Yes	IRPs submitted triennially to the Missouri Public Service Commission.[62]
Montana	Yes	Traditional utilities submit an IRP biennially, while restructured utilities submit an IRP triennially to the Montana Public Service Commission.[63]

[53] **Illinois Power Agency (IPA)**. 2014 Electricity Procurement Plan. [Online] [Cited: October 2, 2014] http://www2.illinois.gov/ipa/Documents/Final-IPA-Procurement-Plan-22-July-2014.pdf.

[54] **Indiana Utility Regulatory Commission (IURC)**. Integrated Resource Plans. [Online] [Cited: October 2, 2014] http://www.in.gov/iurc/2630.htm.

[55] **Borum, Bradley K**. Report of the Indiana Utility Regulatory Commission Electricity Division Director, Dr. Bradley K. Borum, Regarding 2013 Integrated Resource Plans. [Online] April 30, 2014. [Cited: October 2, 2014] http://www.in.gov/iurc/files/Director_2013_IRP_Report_-_Final_4-30-14.pdf.

[56] **Midwest Energy Efficiency Alliance (MEEA)**. Energy Efficiency Policies and Practices in Iowa: Recent MEEA Policy Analysis and Activity – Resource Planning. [Online] [Cited: October 2, 2014] http://www.mwalliance.org/node/1867.

[57] **Kentucky Public Service Commission (KPSC)**. Information about Utilities: Electric Specific Information – Integrated Resource Plan Staff Reports. [Online] [Cited: October 2, 2014] http://psc.ky.gov/Home/Utilities.

[58] **Michigan Public Service Commission (MPSC)**. Department of Licensing and Regulatory Affairs. [Online] [Cited: October 2, 2014] http://www.michigan.gov/mpsc/0,4639,7-159-16377_56260---,00.html.

[59] **Michigan Public Service Commission (MPSC)**. Filing Requirements and Instructions for Certificate of Public Convenience and Necessity Application Instructions. [Online] December 23, 2008. [Cited: October 2, 2014] http://efile.mpsc.state.mi.us/efile/docs/15896/0001.pdf.

[60] The most recent filings in Michigan are from 2010 for Consumers Energy and 2011 for Wolverine Power Cooperative and the Holland Board of Public Works. These filings represent the last time that new generation construction was considered for study by any Michigan utility.

[61] **Minnesota Department of Commerce (MDC)**. Integrated Resource Plans. [Online] [Cited: October 2, 2014] http://mn.gov/commerce/energy/topics/energy-projects/Energy-Regulation-Planning/Integrated-Resource-Plans.jsp.

[62] **Missouri Public Service Commission (MPSC)**. Integrated Resource Planning. [Online] [Cited: October 2, 2014] http://psc.mo.gov/NaturalGas/Integrated_Resource_Planning.

[63] **Wilson, Rachel and Bruce Biewald**. Best Practices in Electric Utility Integrated Resources Planning: Examples of State Regulations and Recent Utility Plans. Prepared by Synapse Energy Economics for the Regulatory Assistance Project. [Online] June 2013. [Cited: October 2, 2014] file:///C:/Users/548762/Downloads/RAPSynapse_WilsonBiewald_BestPracticesinIRP_2013_JUN_21.pdf.

State	IRP	Notes
North Dakota	Yes	Utilities submit biennial IRPs to the North Dakota Public Service Commission.[64]
South Dakota	Yes	Utilities submit biennial IRPs to the South Dakota Public Utilities Commission.[65]
Wisconsin	No	Does not require an IRP, but utilities are required to file a long-term plan. The Wisconsin Public Service Commission conducts a biennial Strategic Energy Assessment to assess the adequacy and reliability of the state's energy supply.[66]

As stated above, some states have processes other than IRPs to meet load requirements. For instance, Illinois has an EPP in place of an IRP, though it has similar guidelines and constraints.[53] There are three main requirements included in Illinois's EPP: an eligible retail customer energy forecast, a current contracted supply, and the type and amount of supply needed to meet load and other legal requirements. The most recent EPP (2014) suggests continuing the strategy from previous EPPs; namely, "hedging load by procuring on and off-peak blocks of forward energy in a three-year laddered approach."[53] The Illinois projection for PJM reserve margins during the 2013-2018 period are approximately 5 percent above the required 15.6 percent level, while MISO reserve margins are also approximately 5 percent above the required 17.5 percent reserve margin over the same period. The 2014 EPP recommends four resources to help meet energy procurement requirements, including incremental energy efficiency, energy procurement strategy, balancing market recommendations, and demand response. In addition, the procurement of renewable resources is included as a mandatory part of the supply for each utility.[53]

Iowa utilities are not required to submit a traditional IRP, but must submit an annual report to the Iowa Utilities Board (IUB).[56] Utilities are permitted to incorporate energy efficiency into their planning for the annual report. Plans for the incorporation of energy efficiency resources into resource planning are scheduled by the IUB and encompass a five-year period. Resource plans for electricity must cover a 20-year period for a forecast of energy requirements.[56]

The Public Service Commission of Wisconsin (PSCW) is required to develop a Strategic Energy Assessment (SEA) every other year, analyzing the "adequacy and reliability of Wisconsin's current and future electrical capacity and supply."[66] The most recent SEA, released in November 2012, forecasts reserve margins over 11.6 percent through 2018, and between 16 and 22 percent in 2013-2014. Utilities have to plan for a 14.5 percent reserve margin during the 2013-2018 period, meaning that utilities are meeting the planning requirement in the near term, but not for the period through 2018. Wisconsin LSEs have been estimated to have minimal net congestion

[64] **Midwest Energy Efficiency Alliance (MEFA)**. Energy Efficiency Policies and Practices in North Dakota. [Online] [Cited: December 10, 2014] http://www.mwalliance.org/policy/ND/utility.

[65] **Midwest Energy Efficiency Alliance (MEFA)**. Energy Efficiency Policies and Practices in South Dakota. [Online] [Cited: December 10, 2014] http://www.mwalliance.org/policy/SD/utility.

[66] **Public Service Commission of Wisconsin**. Final Strategic Energy Assessment: Energy 2018. Docket 5-ES-106. [Online] November 2012. [Cited: October 2, 2014] http://psc.wi.gov/hotTopics/SEA.htm.

costs on the state's transmission system. The state is also forecasted to be a negative net purchaser of interstate electricity, selling at least 215 MW of power. This forecast confirms the results of the CIL/CEL analysis in Section 3.3, which indicates that Wisconsin LSEs will be the last MISO area to experience self-sufficiency issues.[66]

Module E of the MISO Tariff is intended to supplement a state's IRP process.[67] States are allowed to set their own resource planning margins; however, all MISO states have adopted MISO's LRZ planning reserve margins (Exhibit 3-2). MISO does set resource adequacy requirements, and each LSE is responsible for meeting its own requirement.[68] According to MISO's Business Practice Manual for Resource Planning, an LSE that fails to achieve resource adequacy for a planning year will be charged a capacity deficiency charge by MISO, which will then be distributed to the other LSEs in the LRZ.[69]

According to MISO's "Resource Adequacy Principles," MISO works with its stakeholders to develop a resource adequacy construct.[68] MISO is responsible for determining adequacy and ensures that its planning auction supports multiple methods of achieving and demonstrating resource adequacy, such as self-supply, bilateral contracts, and market-based acquisition. MISO allows LSEs to meet their planning resource requirements by:

1. Participating in the Planning Resource Auction;
2. Self-scheduling resources into the auction; or
3. Opting out of the auction by submitting a Fixed Resource Adequacy Plan.

In December 2013, FERC required MISO to remove barriers to participation for external resources.[70] In response, MISO is revising its Power Purchase Agreement qualification requirements.[71] Part of MISO's concern in making these revisions is that external resources need to be available to meet MISO peak demand in a manner comparable to internal resources.

5 Additional Regulation on Plant Emissions

Further complicating attempts to pinpoint MISO's expected capacity reserves are the reinstatement of the Cross State Air Pollution Rule (CSAPR) and the announcement of EPA's proposed greenhouse gas regulations for existing generators. CSAPR was adopted in 2011, prior to the issuance of MATS, but litigation led to it being vacated by the District of Columbia (D.C.) Circuit Court of Appeals; the ruling was then overturned by the United States (U.S.) Supreme

[67] **Midcontinent Independent System Operator, Inc. (MISO)**. Frequently Asked Questions. [Online] Revised January 31, 2013. [Cited: October 2, 2014] https://www.misoenergy.org/Library/Repository/Communication%20Material/About%20Us_FAQ/AboutUs_FAQ.pdf.

[68] **Midcontinent Independent System Operator, Inc. (MISO)**. Resource Adequacy Principles Update – Supply Adequacy Working Group. [Online] August 7, 2014. [Cited: October 2, 2014] https://www.misoenergy.org/Library/Repository/Meeting%20Material/Stakeholder/SAWG/2014/20140807/20140807%20SAWG%20Item%2003%20Resource%20Adequacy%20Principles.pdf.

[69] **Midcontinent Independent System Operator, Inc. (MISO)**. Resource Adequacy Business Practice Manual. BPM-011-r14. September 1, 2014.

[70] **Federal Energy Regulatory Commission (FERC)**. Docket No. ER14-83-000. [Online] December 11, 2013. [Cited: October 2, 2014] http://www.ferc.gov/CalendarFiles/20131211180121-ER14-83-000.pdf.

[71] **Midcontinent Independent System Operator, Inc. (MISO)**. External Resource Qualification – Supply Adequacy Working Group. [Online] August 7, 2014. [Cited: October 2, 2014] https://www.misoenergy.org/Library/Repository/Meeting%20Material/Stakeholder/SAWG/2014/20140807/20140807%20SAWG%20Item%2002%20External%20Resource%20Qualification.pdf.

Court on April 29, 2014.[72] CSAPR has not yet gone into effect, because it is still subject to a stay issued by the D.C. Circuit Court of Appeals. However, it is likely that, in light of the Supreme Court's decision, the stay will be lifted, allowing EPA to begin enforcing CSAPR.

It is difficult to assess the particular impact CSAPR will have on coal plant retirements, because there is significant overlap between the emissions controls required for CSAPR and MATS. A 2011 study by MISO on the effects of the then proposed MATS and CSAPR regulations found that nearly 13 GW of coal-fired generation could be at risk of retirement. It also found that the majority of those retirements would be driven by MATS compliance, with CSAPR compliance playing a lesser role.[73] The study did not, however, provide a breakdown of how many retirements might be caused by CSAPR over and above MATS.

A recent review of CSAPR by SNL Energy indicated that CSAPR will have limited impact on generation. It found that, due to MATS compliance and the increasing shift from coal- to natural gas-fired generation, most of the emissions reductions required by CSAPR and related retirements will have already occurred. It concluded that CSAPR is not likely to cause coal plant retirements beyond those already predicted.[74]

Another limitation to determining the future of coal-fired generation in MISO is the uncertainty surrounding the proposed greenhouse gas regulations, which have not been finalized and may change substantially before EPA adoption. Although EPA proposes to allow states to comply on either an individual state or a regional approach (where states voluntarily form groups to cooperatively meet emissions targets), MISO has not suggested that the MISO states form a region for compliance purposes. MISO recently conducted a study on the impact of the greenhouse gas regulations on MISO's generation resources, which finds that the MISO region could save three billion dollars annually during the compliance period by adopting a regional approach over an individual state approach.[75] The Organization of MISO States and the Midcontinent States Environmental and Energy Regulators, which represent regulators from states within the MISO footprint, are both working on possible regional approaches. However, both groups are in the early stages of evaluation, and neither has a recommended approach at this time.[76,77]

The greenhouse gas regulations, as proposed, set carbon dioxide (CO_2) emissions goals for existing generators in each state. Exhibit 5-1 shows both the 2030 emissions goal (under "Option 1" presented in the proposed regulation)[78] and EPA's 2030 projected base case for each

[72] *EPA v. EME Homer City Generation, L.P.*, 572 U.S. 1182 (2014).

[73] **Midcontinent Independent System Operator, Inc. (MISO).** EPA Impact Analysis: Impacts from the EPA Regulations on MISO. Carmel : MISO, 2011.

[74] **Gelbough, Andy and Jesse Gilbert.** SNL Energy study expects little impact from CSAPR, but some states may be tight. *SNL.* [Online] May 15, 2014. [Cited: July 21, 2014] http://www.snl.com/interactivex/article.aspx?id=28066753&KPLT=6.

[75] **Midcontinent Independent System Operator, Inc. (MISO).** GHG Regulation Impact Analysis – Initial Study Results. [Online] September 17, 2014. [Cited: January 2, 2015] https://www.misoenergy.org/Library/Repository/Meeting%20Material/Stakeholder/PAC/2014/20140917/20140917%20PAC%20Item%2002%20GHG%20Regulation%20Impact%20Analysis%20-%20Study%20Results.pdf.

[76] **Whieldon, Esther.** EPA CO_2 rule may be manageable for RTOs if states adopt cap-and-trade. *SNL*. [Online] August 18, 2014. [Cited: January 5, 2015] https://www.snl.com/interactivex/article.aspx?id=28932399&KPLT=6.

[77] **Tomich, Jeffrey.** Behind the noise, central states study EPA rule cooperation. *E&E News*. [Online] December 3, 2014. [Cited: January 5, 2015] http://www.eenews.net/stories/1060009833.

[78] For the purposes of this analysis, only the state-by-state compliance with Option 1 of the greenhouse gas regulations was considered. EPA has presented two options for compliance: Option 1 uses a 2030 compliance deadline, and Option 2 uses a 2025 compliance deadline.

state located within MISO to present a one-to-one comparison. The 2030 projected base case is EPA's estimation of emission levels from existing sources in each state without these regulations, taking into consideration all other existing regulations.[14] The greenhouse gas regulations' emissions goals are targeted at the average CO_2 intensity of existing power plants in a state. For the states within MISO, EPA's proposed 2030 goals constitute an average of 28 percent fewer CO_2 emissions per MWh of electricity produced, compared to the 2030 projected base case. As Exhibit 5-1 shows, however, goals for each state vary widely, from a low of 10 percent for North Dakota to a high of 48 percent for Texas and Minnesota.[79]

Exhibit 5-1 Existing Source CO_2 emissions in MISO states under the Proposed Clean Power Program (lbs/MWh)

State	2030 Target	2030 Projected Base Case	% Reduction from Base Case
Arkansas*	910	1577	42%
Illinois*	1271	1672	24%
Indiana*	1531	1753	13%
Iowa*	1301	1529	15%
Kentucky*	1763	2168	19%
Louisiana*	883	1316	33%
Michigan*	1161	1826	36%
Minnesota	873	1695	48%
Mississippi*	692	1144	40%
Missouri*	1544	1970	22%
Montana*	1771	2135	17%
North Dakota*	1783	1984	10%
South Dakota*	741	1126	34%
Texas*	791	1529	48%
Wisconsin	1203	1938	38%

Source: NETL using information from EPA's proposed greenhouse gas regulations[14]

*These states are only partially within MISO's geographic footprint.

Because the greenhouse gas regulations propose to give each state significant leeway in deciding how to comply with the regulation, it is difficult to quantify the number of plants that are at risk of retiring as a result. According to EPA's calculations, 49 GW of coal-fired generation nationally will be rendered uneconomic, and thus retired, by the proposed greenhouse gas

[79] It is important to note that MISO entities only operate in portions of North Dakota, Texas, and Minnesota. Most of Texas falls under the purview of the Electric Reliability Council of Texas (ERCOT); a small portion falls under the Southwest Power Pool (SPP). While a majority of North Dakota and Minnesota falls under the MISO umbrella, portions of both states fall under MRO.

regulations under state compliance with Option 1 – a 26 percent reduction.[14] This estimate is for retirements beyond those already projected in the base case scenario. MISO currently has 66.2 GW of coal-fired generation, with 8.2 GW already planned for retirement. An additional 26 percent reduction would leave MISO with only 43 GW of coal-fired generation. Reducing coal-fired generation to 43 GW pushes MISO well into a negative reserve margin.

NERC issued a special report that evaluated the reliability impact of EPA's proposed greenhouse gas regulations on the bulk power grid. The report stated that for MISO, the proposed regulations could lead to a 14 GW reduction in coal-fired capacity – which would leave MISO with 46 GW of coal-fired generation, roughly similar to the 26 percent reduction in the EPA's estimate.[80]

EPA noted in its discussion of retirements that the model it used assumed that NERC reference margins would be met; in other words, the model assumes that sufficient existing generation and/or new generation will be available. In MISO's case, however, it is difficult to understand how this is a reasonable assumption. MISO is facing a serious potential generation shortfall in the near term under existing circumstances; an additional 15 GW of generator retirements over the long term is likely to exacerbate the problem. The compressed timeframe in which these retirements would occur is likely to further compound the issue of near-term shortfalls and reliability issues.

6 Summary

Although the various studies that were recently conducted on generating capacity in MISO North and Central reveal that attempting to predict future capacity and demand is to take aim at an ever-shifting target, they do consistently show cause for concern. Even when it includes 100 percent of unclaimed merchant generating capacity (capacity that is uncertain to be available to MISO's energy markets) MISO is still projecting a generation shortfall in 2016.

There are a number of factors complicating attempts to assess MISO's future resource adequacy. Generators have been slow to announce retirements; even now, only one month from EPA's April 2015 deadline for MATS compliance, 0.9 GW of coal-fired generation remains uncommitted to either retrofitting or retiring.[26] Only 13 percent of the 39.5 GW of generation committed to retrofitting has completed the necessary upgrades. To complete these retrofits in time, MISO has had to extend its outage schedule to include winter months, an action that could reduce the transmission system's reliability. The lessons of the extreme winter weather experienced in early 2014 indicate that a severe weather event coupled with higher than normal outages can stress even those regions that have sufficient capacity to meet NERC's reference margins.

Transmission constraints and the possible limitations on capacity exchanges with neighboring PJM further complicate the picture of resource adequacy in MISO. A robust transmission system could allow MISO to import sufficient capacity to meet its projected shortfall. However, instead of importing from neighboring systems, capacity located within MISO is being committed to export power to serve the PJM's capacity market. Additionally, MISO appears to

[80] **North American Electric Reliability Corporation (NERC).** Potential Reliability Impacts of EPA's Proposed Clean Power Plan. Atlanta: NERC, 2014.

be addressing problems involving transmission-constrained areas by increasingly relying on SSR agreements, which can prevent generation plants from retiring. Further, the analysis in this report shows that MISO North and Central will have a self-sufficiency shortfall by 2016, with anticipated certain capacity. This is at least partly due to transmission constraints leaving capacity stranded within zones.

MISO is limited in its ability to increase the amount of generation in its system and enforce obligations to meet load. MISO has the ability to (and does) set reserve planning margins; however, it is ultimately up to the states to set their own resource planning margins for LSEs. Similarly, while MISO sets resource adequacy requirements, each LSE is responsible for meeting that requirement, and enforcement of an LSE's obligation to meet load generally lies with the state. Therefore, MISO does not have many ways to enforce compliance from the LSEs. It should be noted that all MISO states have adopted the margins set by MISO at this juncture.

Additional EPA regulations also make it difficult to ascertain MISO's future resource adequacy. It is impossible to predict at this time how each of the states within MISO will choose to comply with these regulations, and thus, the subsequent impacts on generation resources. However, EPA's own estimates of generator retirements indicate that MISO may experience 15 GW of retiring generation beyond the 11 GW that MISO itself is predicting through 2016.[75] This is likely to exacerbate the problem, leaving MISO with negative reserve margins in the near future.

Appendix A: ICAP Shortfalls by MISO North Central Transmission Zone

Exhibit A-1 ICAP Shortfall for MISO-Iowa Transmission Zone

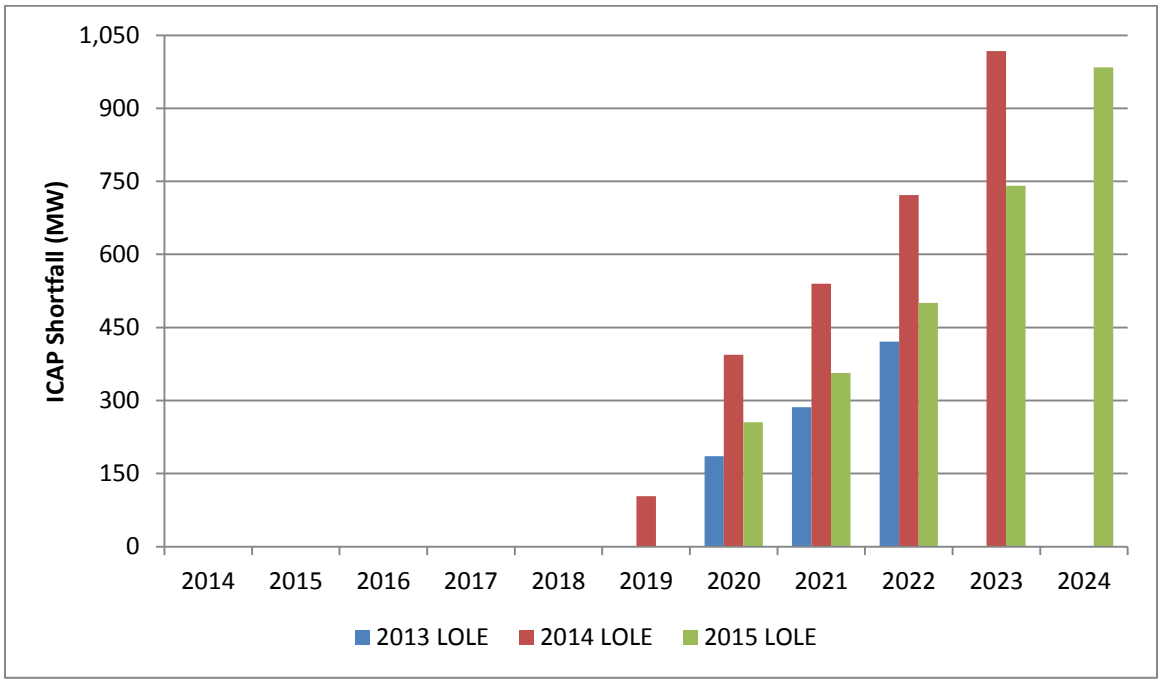


Exhibit A-2 ICAP Shortfall for MISO-Indiana Transmission Zone

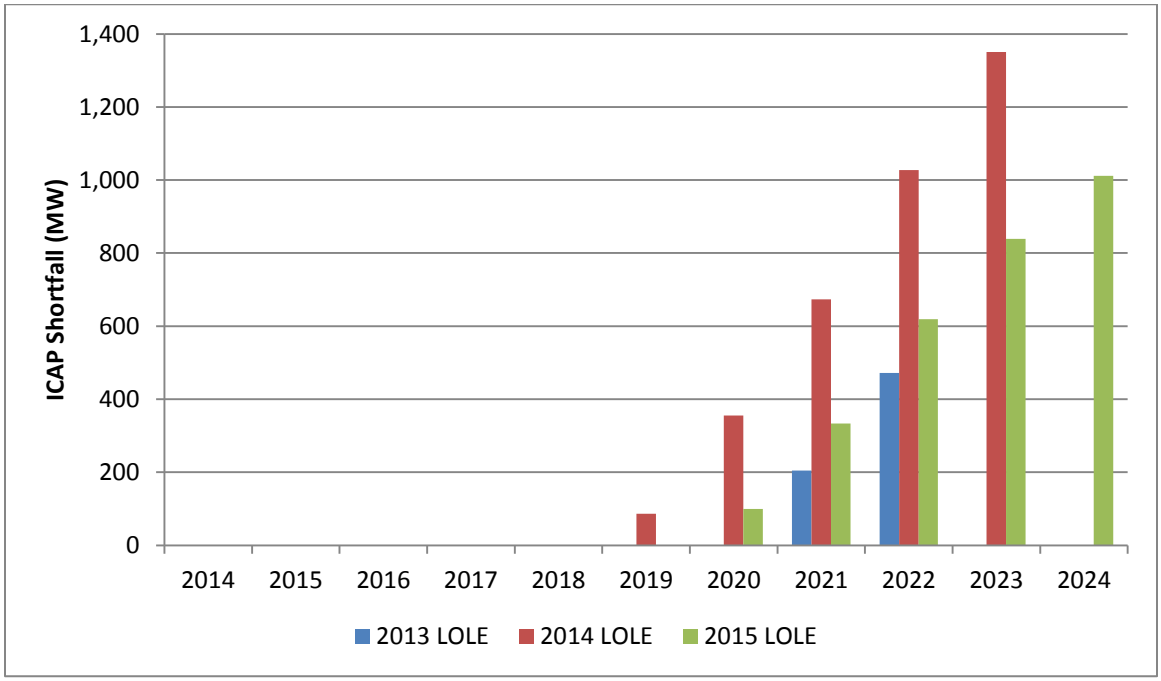


Exhibit A-3 ICAP Shortfall for MISO-Michigan Transmission Zone

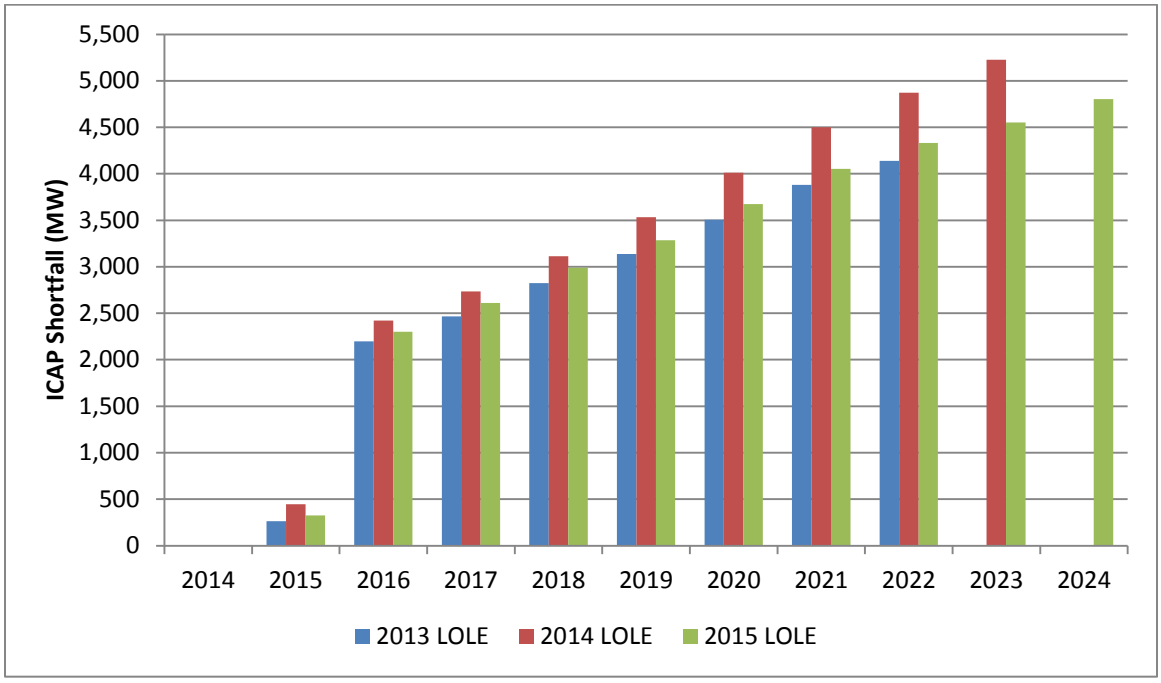


Exhibit A-4 ICAP Shortfall for MISO-Minnesota Transmission Zone

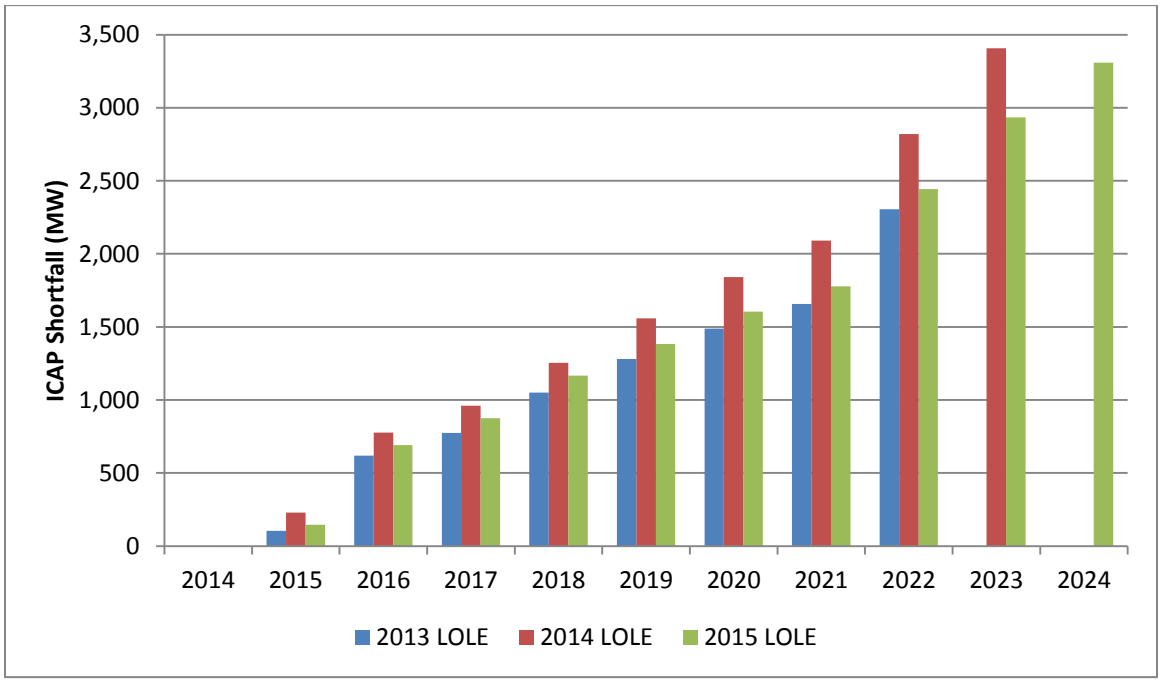


Exhibit A-5 ICAP Shortfall for MISO-North Dakota Transmission Zone

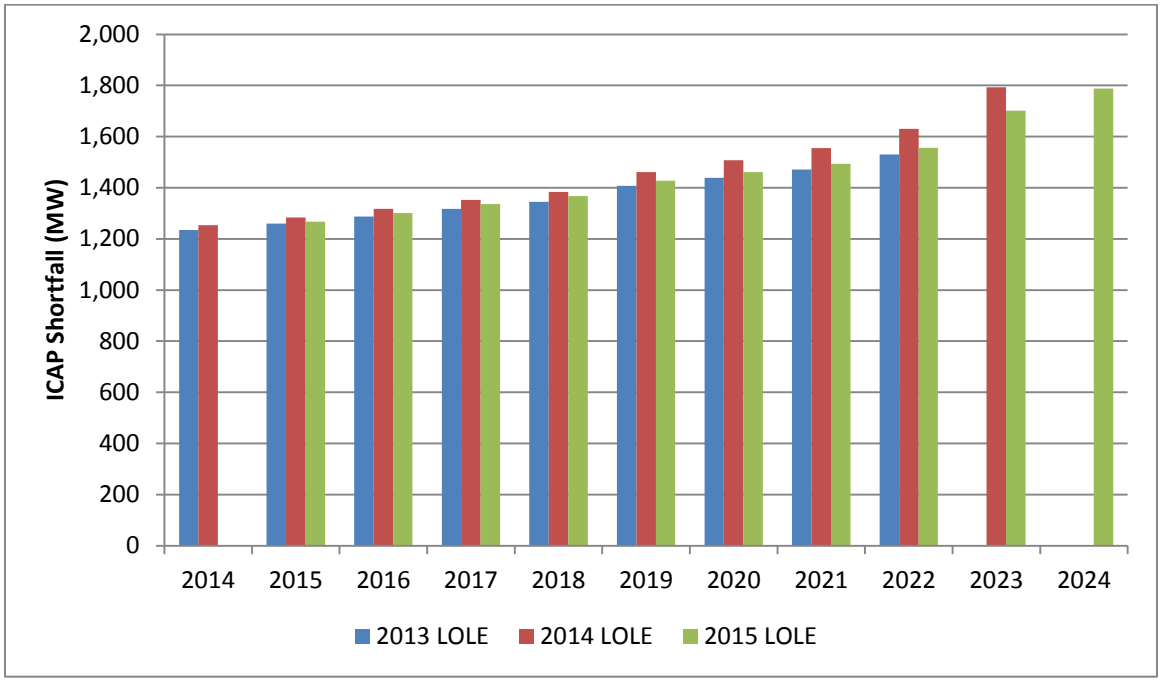
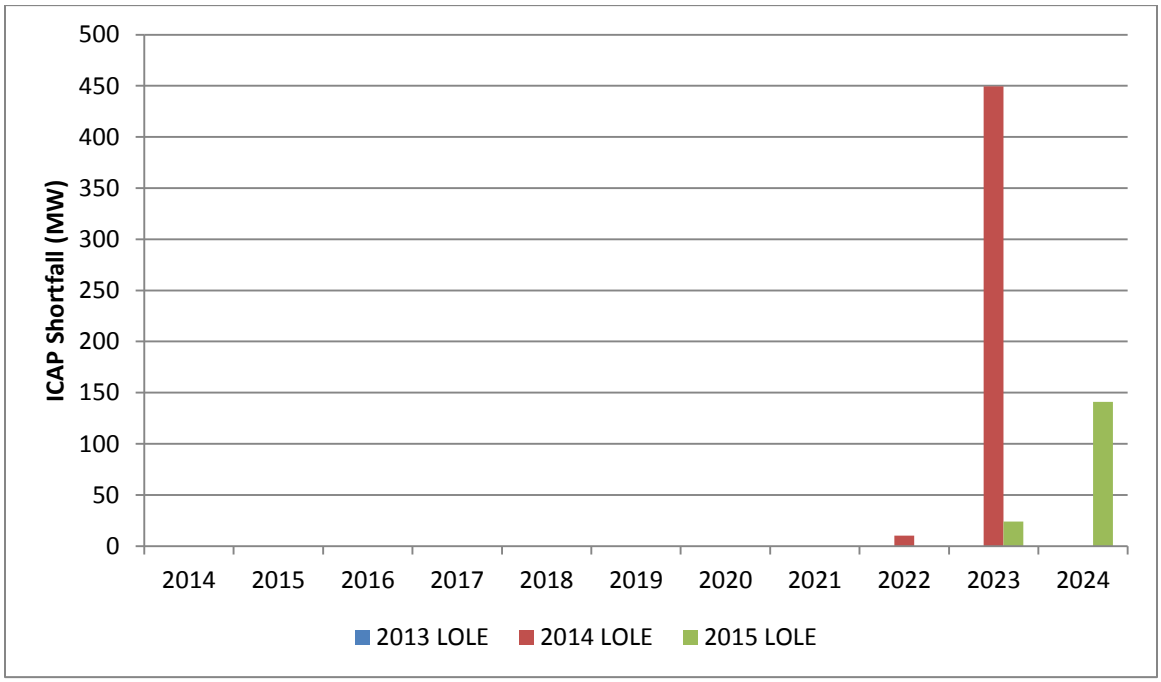


Exhibit A-6 ICAP Shortfall for MISO-Wisconsin/Michigan Upper Peninsula Transmission Zone



Appendix B: Overview of Resource Adequacy Planning Criteria Utilized Across the North American Power System[81]

Exhibit B-1 Resource adequacy planning criteria by region

Region	Planning Criteria	Notes
MISO	0.1 LOLE	
RFC	0.1 LOLE	
PJM	0.1 LOLE	
NYISO	0.1 LOLE	Calculation includes nameplate capacity of all resources including wind. Results are adapted to de-rated unforced capacity (UCAP) for implementation in the NYISO capacity market.
ISO-NE	0.1 LOLE	
SPP	2.4 Loss of Load Hours (LOLH) (0.1 LOLE Equivalent)	Capacity margin criterion of 12% for steam dominant and 9% for hydro dominant RTO members.
MAPP	0.1 LOLE	
SERC	None	
SERC/Southern Company	Economics*	
SERC/Duke-Progress (Carolinas)	0.1 LOLE and Economics	
SERC/Tennessee Valley Authority	Economics	
SERC/Santee Cooper	Economics	
SERC/Louisville Gas and Electric & Kentucky Utilities	Economics	
Entergy (SERC & MISO)	0.1 LOLE	
SERC/South Carolina Electric & Gas	12-18% mandatory reserve margin	
Florida Reliability Coordinating Council	0.1 LOLE	
ERCOT	Non-mandatory 0.1 LOLE	
WECC	None	

[81] **The Brattle Group.** (Prepared for Federal Energy Regulatory Commission [FERC]).Resource Adequacy Requirements: Reliability and Economic Implications. [Online] September 2013. [Cited: October 3, 2014] https://www.ferc.gov/legal/staff-reports/2014/02-07-14-consultant-report.pdf

Region	Planning Criteria	Notes
CAISO	15% state-mandatory reserve margin	
Bonneville Power Administration (BPA)	5% Loss-of-Load probability and conditional value at-risk (CVaR) to evaluate unserved energy events	Different from 0.1 LOLE because BPA is a predominantly hydro system. Loss-of-load probability is not defined in number of hours per year, but as a percentage of planning model iterations that are allowed to have unserved energy events.
Arizona Public Service	0.1 LOLE	
Public Service New Mexico	13% state-mandatory reserve margin	
NV Energy	0.1 LOLE	
Alberta	None	
Maritimes	20% reserve margin and 0.1 LOLE	
Quebec	0.1 LOLE	
IESO (Ontario)	0.1 LOLE	
Saskatchewan	Unserved energy event analysis	
Manitoba	12% reserve margin and unserved energy event analysis	Requires adequate resources to supply firm demand in the event of the lowest coincident river flow conditions (Hydro dependent system).

* Entities using economics-based planning criteria are regulated utilities that do their planning by using cost-benefit analyses that are subject to the approval of their respective state public utility commissions.

Appendix C: ICAP Calculation Inputs*

Exhibit C-1 MISO zonal minimum coincident reserve margins (2014-2025)

Year	MISO	MISO - N/C	MISO - S	Entergy	MISO - Gat	MISO - IA
2014	31.85%	28.48%	41.59%	40.26%	35.90%	26.33%
2015	29.64%	25.98%	40.23%	39.10%	34.68%	25.21%
2016	25.05%	20.24%	39.01%	37.87%	29.24%	22.17%
2017	22.38%	18.02%	35.09%	33.62%	27.87%	18.14%
2018	20.52%	16.15%	33.23%	31.67%	26.32%	16.44%
2019	19.86%	15.85%	31.44%	29.81%	25.17%	14.39%
2020	17.58%	13.35%	29.94%	28.25%	23.73%	11.45%
2021	15.96%	11.78%	28.19%	26.40%	22.38%	10.23%
2022	13.88%	9.79%	25.88%	23.95%	20.93%	8.65%
2023	11.68%	7.40%	24.32%	22.35%	19.01%	5.90%
2024	11.05%	6.79%	23.51%	21.54%	16.89%	3.27%
2025	9.10%	4.55%	22.53%	20.70%	15.71%	1.34%
Year	**MISO - IN**	**MISO - MI**	**MISO - MN**	**MISO - ND**	**SPP-LA**	**WI-UPMI**
2014	28.23%	17.33%	14.79%	-31.59%	52.77%	36.70%
2015	24.84%	12.68%	13.26%	-32.20%	49.59%	34.86%
2016	19.69%	3.05%	9.53%	-32.86%	48.49%	30.22%
2017	18.22%	1.74%	8.40%	-33.54%	47.40%	26.39%
2018	17.36%	0.03%	6.43%	-34.18%	46.25%	25.13%
2019	15.06%	-1.33%	4.94%	-35.89%	45.04%	22.68%
2020	13.78%	-3.02%	3.53%	-36.56%	44.09%	21.11%
2021	12.24%	-4.70%	2.40%	-37.24%	43.19%	18.77%
2022	10.52%	-5.80%	-1.87%	-38.84%	42.01%	16.72%
2023	9.11%	-6.75%	-5.07%	-43.38%	40.89%	14.02%
2024	8.12%	-7.72%	-7.37%	-45.80%	40.02%	13.18%
2025	7.19%	-8.66%	-9.70%	-46.25%	37.83%	11.24%

* NETL calculations using ProMod analysis.

Exhibit C-2 MISO zonal peak net internal demand (2014-2025)

Year	MISO	MISO - N/C	MISO - S	Entergy	MISO - Gat	MISO - IA
2014	120528.3	89577	30951.34	27669.2	20005.89	8164.361
2015	121657.1	90399	31258.05	27905.6	20187.89	8237.361
2016	122799.8	91292	31507.77	28130	20387.89	8319.361
2017	124208.5	92434	31774.48	28371.4	20595.89	8404.361
2018	125503.2	93455	32048.2	28617.8	20795.89	8485.361
2019	125620.9	93303	32317.91	28863.2	20987.89	8572.361
2020	127614.6	95061	32553.63	29075.6	21228.89	8661.361
2021	128910.3	96105	32805.35	29305	21462.89	8757.361
2022	130211.3	97143	33068.35	29543	21693.89	8852.361
2023	131482.3	98194	33288.35	29740	21880.89	8927.361
2024	131493.3	97985	33508.35	29938	22038.89	9003.361
2025	133360.3	99629	33731.35	30137	22250.89	9079.361
Year	**MISO - IN**	**MISO - MI**	**MISO - MN**	**MISO - ND**	**SPP-LA**	**WI-UPMI**
2014	15075.67	19886.26	13926.37	2702.518	3282.136	12555.93
2015	15215.67	20064.26	14049.37	2726.518	3352.451	12669.93
2016	15365.67	20261.26	14194.37	2753.518	3377.767	12794.93
2017	15524.67	20465.26	14333.37	2781.518	3403.083	12922.93
2018	15560.67	20661.26	14466.37	2808.518	3430.398	13025.93
2019	15831.67	20873.26	14609.37	2837.518	3454.714	13148.93
2020	16000.67	21092.26	14774.37	2867.518	3478.03	13319.93
2021	16175.67	21322.26	14937.37	2898.518	3500.345	13464.93
2022	16349.67	21551.26	15103.37	2929.518	3525.345	13609.93
2023	16490.67	21732.26	15227.37	2954.518	3548.345	13725.93
2024	16624.67	21913.26	15341.37	2979.518	3570.345	13805.93
2025	16768.67	22102.26	15488.37	3004.518	3594.345	13957.93

*Drawn from Ventyx Velocity Suite – Historical and Forecast Demand by Zone – Monthly Summary Intelligent Query.[82]

[82] **Ventyx Velocity Suite.** Unit Generation and Emissions – Hourly (with Price) Query). Online. Accessed June 12, 2014.

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